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A VALIDITY STUDY OF THE 1966 GRADE IX
SOCIAL STUDIES DEPARTMENTAL EXAMINATION

by



Halvar de la Cluyse Jonson

A thesis

Submitted to the Faculty of Graduate Studies
in partial fulfillment of the requirements for
The Degree of Master of Education

Department of Secondary Education

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UNIVERSITY OF ALBERTA
FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and
recommend to the Faculty of Graduate Studies for acceptance
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SOCIAL STUDIES DEPARTMENTAL EXAMINATION, submitted by
Halvar de la Cluyse Jonson in partial fulfillment of the
requirement for the degree of Master of Education.

.....10-8-67.....
(Date)

CHAPTER 10

THEORY OF THE EARTH

The following are the main points to be remembered in the study of the theory of the earth.

1. The earth is a sphere and is divided into two parts, the northern and the southern.

2. The northern part is called the northern hemisphere and the southern part is called the southern hemisphere.

ABSTRACT

Part I of The Grade IX Social Studies Departmental of 1966 was comprised of one hundred multiple choice items based on "Bloom's Taxonomy." The purpose of this investigation was to ascertain whether or not this examination showed evidence of sampling a process dimension of evaluation. Specifically, examination results were subjected to tests of construct and concurrent validity to determine whether empirical evidence could be found that this examination required the use of higher mental processes as distinct from the ability to recall content material.

A randomly selected sample of nine hundred and fifty-eight sets of examination scores provided the major portion of data for the investigation. Construct validity was examined through, first, having the test items classified into Taxonomy Categories by judges and comparing this classification to that of the committee designing the examination. Second, the statistical technique of factor analysis was applied to the test results. Test items were analyzed individually and in groups to attempt to determine whether factor patterns could be found which verified the classification of items into recall and higher mental process categories. Concurrent validity was examined by grouping the items of Part I of the examination into recall and high mental process subtests on the basis of the judge and committee classifications and then correlating these subtests with certain external criteria to determine whether they related in a significantly different manner to these criteria. The external criteria utilized were the Principal's Ratings, scores on the School and College

Ability Test, and the scores obtained on Part II, the subjectively scored, written section of the examination.

It was found that the hypothesis, postulating agreement among judges, was supported. Hypotheses further related to the construct validity of the test were not supported. Factor analysis revealed one major factor accounting for a large proportion of the test variance. Examination of various factor solutions, including orthogonal and oblique rotations did not reveal results which could clearly be interpreted in terms of the process dimension the test purported to measure. It was found that the hypothesis postulating a significant difference in the relationship of external criteria to recall and higher mental process subtests was supported in two cases. Principal's Ratings and Part II Scores correlated significantly higher with the recall subtests than with higher mental process subtests. School and College Ability Test scores did not differ significantly in correlating with subtests.

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CHAPTER I

STATEMENT OF THE PROBLEM

I. INTRODUCTION

The 1966 Grade IX Social Studies Departmental Examination represented a pioneer effort to introduce, in an empirically verifiable way, a thought process dimension into provincial examinations in the social studies.

In his report to the Cameron Commission R. S. MacArthur recommended that "continued and increased effort be made to construct objectively scored test items which test such thought processes as understandings and appreciations in addition to factual knowledge."¹ As part of a continuing program to implement such recommendations and thus make departmental examinations more reflective of course objectives, The 1966 Grade IX Social Studies Departmental Examination was designed to examine the attainment of objectives requiring the use of intellectual skills and abilities as distinct from those objectives requiring recall ability.

To provide a structure for their work, those individuals selected by The Alberta High School Entrance Examinations Board to set the examination used Bloom's Taxonomy of Educational Objectives: Cognitive Domain.² The rationale for the test was presented in the following manner:

¹R. S. MacArthur and S. Hunka, School Examination Practices and Standards in Alberta (The Alberta Advisory Committee on Educational Research, University of Alberta, 1960) pp. 40-41.

²B. S. Bloom, Taxonomy of Educational Objectives: Cognitive Domain (New York: David McKay Company, 1965).

"The acquisition of knowledge," "reaching understandings," "the achievement of basic skills," "critical thinking ability," these are expressions commonly found in the literature stating objectives of the social studies. What precisely do they mean? Are they discreet components of the learning process? Can increased clarity be given to these expressions?

Addressing themselves to questions such as these, Bloom and his associates published The Taxonomy of Educational Objectives: Cognitive Domain in which educational objectives are classified with increased clarity and precision. In so doing they not only add a dimension of specificity to guide teachers in defining objectives, but have also enabled test builders to measure more effectively. It is essentially for this reason that "Bloom's Taxonomy" has been used as a guideline in the task of constructing the Grade IX Social Studies Examination.³

Working from this theoretical basis, the committee constructing the examination developed one hundred objective questions of the multiple choice type to form Part I of the examination. Forty of these questions were designed to require various types of recall by the students. The remaining questions were designed to require the utilization of the intellectual abilities and skills which comprise the upper levels of The Taxonomy. Figure 1 is a "blueprint" showing the relative weight given to various areas of content and ability on the objective section of the examination.

These questions provided one hundred of a total of one hundred and thirty marks on the examination. The remaining thirty marks were allotted for written answers to a number of completion and short essay type questions contained in Part II of the examination. Subjective questions were intended to examine student ability to draw on factual knowledge and to manipulate this knowledge through higher mental thought

³Summary Description of Grade Nine Social Studies Objectives and Test Items (The High School Entrance Examination Board, Alberta Department of Education, 1966), p. 4.

TOPIC OR CONTENT AREA

Objectives	Geography Environment and Living	Industrial Expansion Labour and Business Organization	Development of American Culture	Democratic Government in Canada	Home and Community Living	Current Affairs	Inquiry In The Social Sciences	Emphasis
1. Knowledge								40
2. Comprehension								30
3. Application								
4. Analysis								30
5. Synthesis								
6. Evaluation								
	20	15	20	15	5	15	10	100

Note: The topic "Inquiry in the Social Studies" cuts across content areas. It will be used for items that involve more than one content area or that involve inquiry, as, for example, Items 3 - 6 in "Evaluation" p. 38-39.

FIGURE I

BLUEPRINT OF GRADE IX SOCIAL STUDIES EXAMINATION

(Taken from the Summary Description of Grade Nine Social Studies Objectives and Test Items
(Department of Education, University of Alberta at Edmonton, 1960), p. 9)

processes.

This study was undertaken to determine whether or not the results obtained on the examination could be used to verify the division of the objective items into recall, and intellectual ability and skill categories.

II. PROBLEM

This investigation seeks to answer the following question: Do the results obtained by a randomly selected sample of students on this examination, when subjected to tests of construct and concurrent validity, show evidence that the examination did require the use of intellectual abilities and skills as distinct from the ability to recall factual material?

III. NEED FOR THE STUDY

Contrary to the objectives of educators, many currently used tests have tended to emphasize tasks requiring only the recall of specific content material. Others do require additional abilities but in many cases no assessment of these requirements has even been made. In order that an instrument of evaluation may accurately reflect the goals and purposes of the educational process, test situations should offer the student the opportunity to use various thought processes and guarantee that performance in these areas will be recognized. "A major problem of educational measurement has been finding ways and means of multiplying the measurable dimensions of educational achievement to the point where they come as close as possible to encompassing all the important categories of behaviour that are likely to be acquired inside and outside

the classroom."⁴ In connection with this basic problem Bloom stated, "The most cursory reading of the tests available...would indicate that tremendous emphasis is given in our schools to this kind of remembering or recall."⁵

Further documentation is provided by the discussion of purpose found in curriculum guides and testing manuals. Creators of tests are apparently cognizant of the desirability of constructing items which call for the use of thought processes in addition to the recall of factual material. However, as yet few attempt to do this. A review of the Stanford Achievement Test indicated that, "It is hard to see how the first two of these tests (Social Studies and Science) reflect the trend towards the teaching of meanings and understandings rather than mere factual knowledge to which the authors pay their respects in the manual...these tests still deal with miscellaneous knowledge rather than with problem-solving skills, critical understandings and applications of learning."⁶

The fact that many tests measure only recall processes presented a second major problem. Because of his perception of what the test calls for, the activities the student engages in, in preparation for a test, will be centered around memorizing material, rather than understanding

⁴Henry S. Dyer, "Educational Measurement--Its Nature and Problems," Evaluation in The Social Studies, Thirty-Fifth Yearbook of The National Council for the Social Studies (Washington, D. C. Department of National Education Association, 1965). p. 41.

⁵Benjamin S. Bloom (ed.) Taxonomy of Educational Objectives Handbook: I Cognitive Domain (New York: David McKay Co. Inc. 1961), p. 30.

⁶Oscar K. Buros (ed.), The Fifth Mental Measurements Yearbook (Highland Park, New Jersey: The Gryphon Press, 1959), pp. 78-80.

concepts and ideas. Merkhofer⁷ indicated that the extent to which students try to memorize material in contrast to the development of problem solving skills directed toward the application of ideas and methods tends to be directly related to the nature and type of examination the students expect to receive.

A third aspect of this problem involved most teachers being aware of the objectives being tested by various tests, tending to stress these kinds of learning experiences. Tyler reported that The Regent's Inquiry into The Character and Cost of Public Education in New-York State found that teachers, "were conscious of the objectives being tested in the examinations and sought to emphasize these kinds of learning in their classes rather than to follow the objectives recommended in the local curriculum guides."⁸

The preceding studies suggested that when the items in an achievement test encourage the student to use his intellectual abilities, the test itself will have a constructive influence on the learning process. However, if the major emphasis of an achievement test is placed upon rote learning and recall of specific facts, the test may act as a deterrent to learning experiences.

This is not to say that factual knowledge is not important.

⁷B. E. Merkhofer, "College Students Study Behavior" unpublished Ph. D. dissertation, University of Chicago, 1963).

⁸Ralph W. Tyler, The Regent's Inquiry into the Character and Cost of Public Education, "Invitational Conference on Testing Problems - 1959 - Proceedings" (Princeton, New Jersey: Educational Testing Service, 1960), p. 11.

Whitehead⁹ and Dressel¹⁰ would indeed agree that the acquisition of knowledge is an important outcome of instruction. They would also recognize, however, that learning experiences must provide the student with the ability to integrate and apply material which otherwise might remain isolated. Methods of evaluation must, therefore, be designed to reinforce the educational processes which increase the student's ability to handle problems by analyzing or understanding the new situation, by applying a whole body of knowledge which is readily available, and by relating appropriate elements of past experience.

These aforementioned problems are particularly apparent in evaluating the social studies. Engle revealed the basis for these problems as he pointed out the importance of decision making.

...In teaching the social studies, we should emphasize decision making as against mere remembering. We should emphasize decision making at two levels: at the level of deciding what a group of descriptive data means, how these data may be summarized and generalized, what principles they suggest; and also decision making at the level of policy determination, which requires a synthesis of facts, principles and values usually not all found on one side of any question.¹¹

In the specific case studied the same basic set of objectives was held, the attainment of which, if they were to be measured, required the assessment of students' higher level cognitive processes. The Junior High

⁹Alfred N. Whitehead, The Aims of Education and Other Essays (New York: The New American Library, 1961).

¹⁰Paul L. Dressel and Associate, Evaluation in Higher Education (Boston: Houghton Mifflin Co., 1961).

¹¹S. H. Engle, "Decision Making: The Heart of Social Studies Instruction," Crucial Issues in The Teaching of the Social Studies (Englewood Cliffs, New York: Prentice Hall Inc., 1964), p. 28.

School Curriculum Guide presents the grade nine social studies course objectives in this way.

In this course, objectives for each unit are listed under three headings--(1) understandings, (2) skills, abilities and habits, (3) attitudes. This does not mean that factual knowledge is not required for generalizations are based on facts. It is well known that facts elude the memory if they are not being used constantly, but a generalization, which is the result of reasoning, is an enduring gain which may be used in further critical thinking.¹²

If the attainment of objectives requiring the use of intellectual skills and abilities can be shown to be a distinct and empirically recognizable part of an examination, a significant step will have been taken towards solving these problems in evaluation. If investigation of the results of using this testing instrument shows evidence that it measures attainment in the area of higher mental processes and can distinguish this attainment from mere recall, then instruction may be allied more closely to course objectives in Grade IX Social Studies.

Several studies have dealt with the measurement of intellectual processes. However, as Crawford¹³ points out these projects have been conducted under artificial conditions. Test items are usually specially constructed by researchers involved in a special project rather than by public educators as part of the regular school program. An example of such work is found in the final report of a U. S. O. E. project completed

¹²Department of Education of Alberta, Junior High School Curriculum Guide for Social Studies - Language (1963 Edition).

¹³William R. Crawford, "The Empirical Validity of Items Constructed to Measure Complex Intellectual Processes," (an unpublished paper presented to the 1967 Annual Meeting of The American Educational Research Association).

by Kropp, Stoker and Bashaw.¹⁴ This type of work is useful in terms of basic research, but it provides little evidence with respect to the outcomes which could be expected if items were constructed by practising educators and were part of regular examination procedures as was the case in the construction and administration of The 1966 Grade IX Social Studies Departmental Examination.

IV. HYPOTHESES

The basic problem of the study was approached by applying tests of construct and concurrent validity to the examination and the examination results.

Construct Validity. Investigation of the construct validity of the examination was based on the following hypotheses.

Hypothesis (A1) A group of twelve judges, judging independently, will reach agreement in classifying the objective items of the test into knowledge and higher mental process categories.

Hypothesis (A2) The responses to the objective items classified in each Taxonomy category will correlate positively.

Hypothesis (A3) Factor analysis of correlations among items will result in higher mental process items loading on factors in a manner distinct from the loading of recall items.

Concurrent Validity. Investigation of the concurrent validity of

¹⁴R. P. Kropp, H. W. Stoker and W. H. Bashaw, The Construction and Validation of tests of the cognitive processes as described in The Taxonomy of Educational Objectives. U. S. Office of Educational Cooperative Research-Project No. 2117. Tallahassee, Florida: Florida State University, 1966.

the examination was based on the following hypotheses.

Hypothesis (B1) A positive correlation will be obtained between scores on objective test items identified as requiring only recall and

(a) SCAT Total Scores

(b) SCAT Verbal Sub-Scores

(c) SCAT Quantitative Sub-Scores

(d) Principals' Ratings

(e) Examination Sub-Scores from the Essay Section,

Part II of The Examination

Hypothesis (B2) A positive correlation will be obtained between scores on objective test items identified as requiring higher mental processes and the criteria presented in hypothesis B1.

Hypothesis (B3) Correlations obtained while testing hypothesis B1 will differ significantly from correlations obtained while testing hypothesis B2.

V. ASSUMPTIONS

The following statements of Henry S. Dyer and Robert W. McFall outlined the assumptions on which the preceding hypotheses were based.

Assumption One (relevant to hypotheses A1, A2, and A3.)

The construct validity of a test may be determined by three steps:

(a) First, can a group of any twenty examiners, judging independently, agree reasonably well on classification of responses?

(b) Do the responses classified as one or the other tend to hang together empirically? That is, do the responses rank children in the same order?

(c) Third, is the agreement in rank order within one set of responses distinguishably greater on the average than the agree-

ment between different sets of responses? If the answers to all three questions are in the affirmative, then it can be said that the test is measuring these constructs.¹⁵

Assumption Two (relevant to hypotheses B1, B2, and B3)

Concurrent validity will be established if:

- (a) There is a positive relationship between scores on test items which involve only the recall of specific area of study.
- (b) There is a low relationship between scores on test items which do not involve the recall of specific content material and current methods of evaluating student achievement in a specific area of study.
- (c) The relationship between items requiring only the recall of specific content material and the relationship between test items which do not require the recall of specific content material and the criterion variables are significantly different.¹⁶

VI. DELIMITATIONS

Consideration was given only to examining the dichotomous recall--higher mental process facet of the examination in terms of construct and concurrent validity.

- (1) No attempt was made to assess the level of attainment of any individual or group of individual marks.
- (2) No comparisons were made among any parts of the sample population.
- (3) No attempt was made to produce statistical evidence to justify or identify the entire hierarchy of Bloom's Taxonomy.
- (4) No assessment was made of the examination's content validity.

¹⁵Henry S. Dyer, "Educational Measurement--Its Nature and Problems." Evaluation in the Social Studies (Washington, D. C., N.C.S.S., 1965), p. 70.

¹⁶Robert W. McFall, "The Development of Validation of an Achievement Test for Measuring Higher Level Cognitive Processes in General Science," The Journal of Experimental Education (XXXIII), Autumn, 1964), pp. 103-106.

(5) No value judgment was attempted with respect to the relative merits of the examination.

VII. DEFINITION OF TERMS

Cognitive Domain--"those objectives which deal with the recall or recognition of knowledge and the development of intellectual skills and abilities."¹⁷

Concurrent Validity--"is concerned with the relation of test scores to an accepted contemporary criterion of performance on the variable which the test is intended to measure."¹⁸

Construct Validity--is concerned with "what psychological qualities a test measures" and is evaluated by "demonstrating that certain explanatory constructs account to some degree for performance on the test."¹⁹

Content Validity--"is concerned with the adequacy of sampling of a specified universe of content."²⁰

Higher Level Cognitive Processes--those processes of thought which involve using an additional mental ability in utilizing recalled material.

Judge--someone deemed to be familiar with the grade nine social studies and with The Taxonomy.

Knowledge--as an objective defined by Bloom, involves "the recall

¹⁷Bloom, op. cit., p. 7.

¹⁸Robert L. Ebel, Measuring Educational Achievement (New York: Prentice-Hall Inc., 1965), p. 380.

¹⁹Ibid.

²⁰Ibid.

of specifics and universals, the recall of methods and processes, or the recall of a pattern structure or setting. For measurement purposes the recall situation involves little more than bringing to mind the appropriate material."²¹

Principals' Ratings--those grades recommended by principals to The Department of Education for those students intending to write the Grade IX Social Studies Departmental Examination.

SCAT Scores--the scores obtained by students on the School and College Ability Test administered in Grade IX.

The Taxonomy--refers to Bloom's Taxonomy of Educational Objectives: Cognitive Domain.²²

VIII. ORGANIZATION OF THE STUDY

This Chapter contains a statement of the problem, a discussion of its significance, and an outline of its hypothetical basis in the study. Also stated and defined were the delimitations of and terms essential for understanding the study. The remainder of the investigation is organized in the following way:

Chapter II contains a survey of related literature. The first part of the chapter is a documentation of the basic problem of making achievement tests more reflective of course objectives. Following this, methods of approaching the problem are reviewed. Finally, research on the identification of mental processes and the use of The Taxonomy is summarized.

Chapter III contains a description of the procedure followed and

²¹Bloom, op. cit., p. 48.

²²Ibid.

statistics used in studying the construct and concurrent validity of the examination.

Chapter IV contains the findings of the investigating procedure described in Chapter III. The first part of the chapter deals with the results of attempting to establish construct validity and the second deals with the results of attempting to establish concurrent validity.

Chapter V contains conclusions, implications, and suggestions for further research arrived at from the findings of Chapter IV.

CHAPTER II

REVIEW OF THE LITERATURE

INTRODUCTION

No previous Alberta Departmental Examination in the Social Studies had the same physical structure or theoretical basis as that of 1966. The 1965 Science IX Departmental Examination was primarily a multiple-choice objective examination based on "The Taxonomy" but no follow-up investigation of the results of its use has yet been made public. Bodnaruk,¹ Eddy,² Sabey,³ and Truckey⁴ did research on recent Grade IX Social Studies Departmentals but these studies were of a comparative and local nature. Studies which would be equated to studying the validity of an application of The Taxonomy to a Departmental Examination on social studies were non-existent.

However, the construction of this examination and the study of its construct and concurrent validity was representative of an effort to ap-

¹Bodnaruk, "A Comparative Study of Examination Results, Grades IX and XII, in One Town School and In Three Rural Centralized Schools in The County of Ponoka" (unpublished Master's Thesis, The University of Alberta, Edmonton, 1962).

²W. P. Eddy, "A Study of Certain Characteristics of Teachers in Relation to Grade IX Social Studies" (unpublished Master's Thesis, The University of Alberta, Edmonton, 1966).

³R. H. Sabey, "A Comparison of The Achievement of Grade IX Pupils In Various School Organizations" (unpublished Master's Thesis, The University of Alberta, Edmonton, 1966).

⁴L. A. Truckey, "Comparison of Achievement of Grade Nine Students in Selected Single Grade and Multi-Grade Classes in Alberta" (unpublished Master's Thesis, The University of Alberta, Edmonton, 1964).

proach the frequently publicized problem of making mass evaluative instruments more reflective of the objectives they purport to measure. "Bloom's Taxonomy" represented one effort of educational psychologists to classify educational objectives in such a way that a much needed process dimension was added. A limited number of recent studies have revealed that The Taxonomy is finding application in efforts to add a mental process dimension to testing in various subject fields.

II. EDUCATIONAL OBJECTIVES AND MASS EVALUATION

With the phenomenal expansion of public education and the consequent expansion of mass testing procedures there has developed a concern for keeping evaluative procedures reflective of course objectives. As Thorndike states:

The process of measurement of achievement is secondary to that of defining educational objectives. The ends to be achieved must be formulated clearly. Then measurement procedures can be sought as tools for appraising the extent to which these ends have been achieved.⁵

Lindquist, writing of the same problem, described the direction in which the measurement of objectives tends to be perverted.

Where no authoritative statements of immediate objectives have been available and where such objectives have not been sufficiently specific or meaningful, the test constructor has often set up or derived his own immediate objectives for the test. He has usually derived these objectives, however, not from any general ultimate objectives, but from the common content of current instruction.⁶

⁵R. L. Thorndike and E. Hagen, Measurement and Evaluation in Psychology and Education (New York: John Wiley and Sons, 1961), p. 1.

⁶E. F. Lindquist, Educational Measurement, (Washington, D. C.: American Council on Education, 1950), p. 133.

He further identified the source of the problem in the process of test construction.

Analysis of testbooks and courses of study has contributed the most common technique for validating educational achievement tests. Accordingly, just as the real objective of instruction has been to teach what is in the textbook, so, in many instances the real objective in testing has to an even greater degree been "to test for recall of what is in the textbooks, or to test what is now being taught."⁷

Downey reiterated this position when he stated that the practice of testing only a student's mastery of factual material was a "vicious" thing and would only lead to "the distortion of the educative process if carried on intensively."⁸

Engle,⁹ Lewenstein, and Massialas have pointed out that the problem is particularly apparent in evaluation of the social studies. Lewenstein states, "the recall of fact should be distinguished from behaviours which indicate understanding, the ability to show insight, to make new associations, or to apply concepts to new situations which the respondents have never faced before."¹⁰ Massialas summarized the present position of social studies testing when noting first, that there is a lack of research dealing with evaluation in the social studies and second, that most of the tests and manuals that accompany social studies textbooks include ques-

⁷Ibid., p. 130.

⁸L. W. Downey, Introductory Address to an Institute on Testing, Lacombe, Alberta, 1964, p. 3.

⁹S. H. Engle, "Objectives of The Social Studies," New Challenges in the Social Studies (Belmont, California: Woodsworth Publishing Co., 1965).

¹⁰Morris R. Lewenstein, Teaching Social Studies in Junior and Senior High Schools (Chicago: Rand McNally and Co., 1965), p. 462.

tions which, generally, require only recall.¹¹

Davies and Tinsley¹² analyzed the classroom communication of social studies teachers. Their findings supported the generalizations of Massialas and Lewenstein as being applicable to the classroom situation as well as to tests and textbooks. Results of the study indicated that most questions asked by social studies teachers are procedural in nature or require pupil memory and that higher order objectives are seldom behaviourally operational.

III. THE CLASSIFICATION OF OBJECTIVES

Authorities generally seemed to agree that solving this problem must begin with a clear classification of objectives. As Ebel has stated "part of the reluctance of teachers to base their tests on course objectives has been due to inadequate statements of educational objectives available to them."¹³

In answer to this need various attempts at classification have been made. Kearney¹⁴ prepared a comprehensive statement of elementary school objectives for the Mid-Century Committee on Outcomes in Elementary

¹¹B. G. Massialas and A. M. Kazamias (editors), Crucial Issues in The Teaching of Social Studies (Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1964), p. 219.

¹²O. L. Davies, Jr. and Drew C. Tinsley, "Cognitive Objectives Revealed by Classroom Questions Asked by Social Studies Teachers," (unpublished paper presented to the 1967 Annual Meeting of The American Research Association).

¹³Ebel, op. cit.,

¹⁴N. C. Kearney, Elementary School Objectives (New York: Russel, Sage and Co., 1953).

Education. French and associates¹⁵ prepared somewhat similar treatments of secondary school objectives. The Taxonomy represented the most comprehensive classification to date in the cognitive area of objectives. In The Handbook I: Cognitive Domain Bloom outlines why these objectives were central to achievement test development.

The cognitive domain which is the concern of this handbook, includes those objectives which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills. This is the domain which is most central to the work of much of current test development. It is the domain in which most of the current work in curriculum development has taken place and where the clearest definitions of objectives are to be phrased as descriptions of student behaviour.¹⁶

IV. THE VALIDATION OF OBJECTIVE ATTAINMENT

Once a set of objectives is arrived at there is the need to construct an instrument to judge its attainment. Also, there is the fundamental need to apply the tools of measurement to validate its use. Dyer contended that:

At the present time there is a tendency to think carelessly of achievement in any academic area as one dimensional. The single final grade in a course, the single score on most standardized achievement tests reinforce this tendency. Although any good test, as noted above, represents an effort to sample several aspects of learning in any particular field, there is almost never any systematic attempt to investigate the hypotheses inherent in the test construction process. The question of construct validity is left dangling.¹⁷

¹⁵W. French and others, Behavioural Outcomes of General Education in High School (New York: Russel, Sage and Co., 1957).

¹⁶Bloom, op. cit., p. 7.

¹⁷H. S. Dyer, "Educational Measurement--Its Nature and Problems," Evaluation in Social Studies, Thirty-Fifth Yearbook of the National Council for the Social Studies (Washington: NCSS, 1965), p. 41.

Several attempts have been reported to validate testing instruments based, entirely or in part, on The Taxonomy.

The work of McGuire¹⁸ involved the construction and use of 683 test items. Three subject matter experts independently classified these items according to an eight level taxonomy of intellectual processes adapted from The Taxonomy. The raters unanimously agreed on the classification of 61 per cent of the items rated; an additional 13 per cent, one rating diverged from the other two by only one level. Two or more raters agreed on 93 per cent of the items. An attempt to determine the degree of correspondence between the intellectual processes actually employed by examiners and that described by the experts provided results of limited usefulness.

From statistical analysis of results for a comprehensive examination constructed according to a revised taxonomy, McGuire concluded that the items at each level of The Taxonomy appeared to be measuring somewhat different intellectual skills. Findings from factor analysis of the correlation matrices supported the hypothesis that there is a fundamental kind of knowledge, understanding, or intellectual skill basic to all processes.

Stoker and Kropp¹⁹ used two reading comprehension tests in which items were classified according to the six levels of The Taxonomy. Class-

¹⁸C. McGuire, "Research in the Process Approach to the Construction and Analysis of Medical Examination" Twentieth Yearbook of the National Council on Measurement in Education, (East Lansing, Michigan: Office of Evaluative Services, 1963), pp. 7 - 16.

¹⁹H. W. Stoker and R. P. Kropp, "Measurement of Cognitive Processes," The Journal of Educational Measurement I: 39 - 42, June, 1964.

ification of items by judges and the application of Guttman's simplex theory to inter-item correlation matrices supported the hierarchical structure of The Taxonomy. There was evidence, however, that the evaluation category may be misplaced. Factor analysis provided evidence to support the knowledge - higher mental process division of items but failed to differentiate among the upper levels of The Taxonomy.

Connolly and Wantman²⁰ recorded the oral responses of students to test items based on Bloom's Taxonomy. Although their primary motive was to identify types of problem solving difficulties, they noted a division between recall or memory responses and those exhibiting the use of higher mental processes.

Berlin²¹ in doing his research on structured learning situations found some evidence for justifying Bloom's hierarchy of objectives. In particular, he drew attention to the evident division between responses to the knowledge objective and those above. He noted, however, that the process of translation which was, according to Bloom, part of comprehension might better be considered a knowledge objective.

Ayers²² conducted extensive factor analysis on a forty item, four option multiple choice test administered to 297 students in an Edmonton

²⁰J. A. Connolly and M. J. Wantman, "An Exploration of Oral Reasoning Processes in Responding to Objective Test Items," Journal of Educational Measurement, I: 59 - 64, June, 1964.

²¹B. M. Berlin, "The Relationship of Learning Experiences of Students to Certain Structured Learning Situation," (Doctoral Thesis, University of Chicago, 1965) (Microfilm)

²²J. D. Ayers, "Justification of Bloom's Taxonomy by Factor Analysis," (unpublished paper, Department of Educational Psychology, University of Alberta).

School, immediately after they had completed a Grade 10 science unit on the gas laws. From his analysis he concluded: "In general this factor analytic study of the items within a relatively short test supports Bloom's notion of hierarchical structure, but there is some question whether or not the same factors and hierarchical order will be confirmed."²³

Crawford²⁴ administered a collection of 723 test items, divided into eight item groups to 475 American college students and attempted to ascertain the validity of these items in testing higher mental processes. Rotated factors were extracted from forty-two subject matter and thirty-nine taxonomic matrices. The factors so extracted could not be defined in terms of levels of mental processes. "The patterns of factors obtained suggested that items from the same subject matter which load on different factors may define subject matter sub-categories, and that items from different subject matter categories which have loadings on the same factor might deal with the same general topic or concept."²⁵

Taking the concurrent approach to validation, McFall²⁶ constructed and conducted a study of an experimental test composed of 35 multiple choice items dealing with the area of general science and concentrating

²³Ibid., p. 4.

²⁴William R. Crawford, "The Empirical Validity of Items Constructed to Measure Complex Intellectual Processes," (an unpublished paper presented to the 1967 Annual Meeting of The American Educational Research Association).

²⁵Ibid., p. 7.

²⁶Robert W. McFall, "The Development and Validation of an Achievement Test for Measuring Higher Level Cognitive Processes in General Science," The Journal of Experimental Education, 33: 103-6, Fall, 1964.

specifically on the relationship between plants and animals. The first section of the test (subtest A) included items designed to provide an indication of the student's ability to recall specific and isolated bits of information. The second section (subtest B) utilized a problem solving approach in order to identify the ability to deal with tasks requiring higher level cognitive processes. Teachers administered the test to 17 general science classes in grades seven to eleven. Subtest results were correlated with three "current methods of evaluating student achievement" as follows:

- (a) present class grade
- (b) total score The Stanford Achievement Test J - advanced battery - 1953
- (c) score on the Science Section of the Stanford Achievement Test (Form J - advanced battery - 1953)

McFall's hypotheses were supported as in all three comparisons subtest A had a significantly higher correlation with the external criteria than did subtest B. He found a similar relationship between the subtests and scores on The Otis Quick-scoring Mental Abilities Test. In his concluding statement he wrote, "a well validated measuring device constructed to reflect the need to emphasize critical understandings and problem-solving skills in conjunction with the acquisition of content material can facilitate a review of educational goals and the processes directed toward the realization of these objectives."²⁷

²⁷Ibid., p. 106.

V. THE MEMORY FACTOR

The attempt to isolate a basic memory or knowledge objective has a history which goes beyond Bloom's Taxonomy.

Cronbach²⁸ said that the depth of understanding depends in part on the nature of the material, and that its measurement depends on the kinds of items used. There is a suggestion in discussions such as this that recall of knowledge depends on memory alone and that reasoning involved more than this.

Thurstone²⁹ identified a memory factor in his factor analytic studies and included it among his "Primary Mental Abilities." The tests which were related to this factor involved paired associates and recognition items.

Hilgard³⁰ cited experiments which showed that memory for number sequences was better when a principle of organization was understood, than when the sequences were learned by rote. Another experiment indicated that memory of application of principles in college biology was better than memory for terminology.

More recently Vernon³¹ has reviewed the evidence for memory

²⁸L. J. Cronbach, Educational Psychology (New York: Harcourt, Brace and Company, 1954).

²⁹L. L. Thurstone, Primary Mental Abilities (Chicago: The University of Chicago Press, 1938).

³⁰E. R. Hilgard, Introduction to Psychology (New York: Harcourt, Brace and Co., 1957).

³¹P. E. Vernon, The Structure of Human Abilities, (London: Methuen and Co. Ltd., 1961).

factors. In doing so he pointed out that Thurstone's tests do not bear much resemblance to learning, retention or recall in everyday life. He cited other evidence to support the existence of a rote memory factor, but noted that in all cases short term memory is involved. In an investigation where delayed memory was tested, the tests did not load on the rote memory factor but on the verbal factor.

Hukins³² in his factorial investigation of science tests, after reviewing evidence for a recall factor, concluded that:

In a factorial investigation, a test of knowledge involving simple recall type items would have high loadings on a verbal factor if such a factor is obtained in the analysis. If a general intellectual ability factor is obtained the test of knowledge probably would have loading on this factor also. However, if the analysis yields a reasoning and a verbal factor, it is likely that the test would have small or zero loading on the reasoning factor."³³

VI. SUMMARY

Writers have expressed the need to provide achievement tests which are more consistent with objectives. Also described is the tendency for these evaluative instruments, as they now exist, to overemphasize the knowledge objective.

Proposed solutions to the problems have had two stages. First, there have been efforts to provide clearer and more complete classifications of objectives. Second, there has been the effort to construct and

³²A. A. Hukins, "A Factorial Investigation of Achievement of Objectives in Science Teaching" (unpublished Ph. D. thesis, Department of Secondary Education, University of Alberta, 1963), p. 10.

³³Ibid., p. 10.

validate objective tests which evaluate these objectives. In this second stage subject area evaluators have made much use of the research base of educational psychologists who have attempted to identify and test for memory and other mental abilities.

Bloom's Taxonomy is one product of the work of educational psychologists which has and is finding considerable application in various subject fields, particularly science. Research to date has been inconclusive in validating the entire hierarchy of the Taxonomy in different subject areas but studies have shown fairly consistent identification of higher mental processes as distinct from knowledge or recall.

CHAPTER III

DESIGN OF THE INVESTIGATION

I. THE EXAMINATION - PART I

The 1966 Grade IX Social Studies Departmental Examination was the product of a six member committee working under the auspices of the High School Entrance Examinations Board. The multiple choice items initially chosen from a bank of approximately five hundred items for Part I of the examination were used in a pilot study in which they were administered to a group of Edmonton Grade X Students. The results of this study were used as a basis for accepting, rejecting and modifying questions to attempt to insure that the items appearing on the final version of the test evinced reliability and discriminatory power. One hundred multiple choice items, thus arrived at, were administered to Alberta Grade IX Students as Part I of the examination.

The biserial correlation with the total test score and the difficulty index for each item is recorded in Appendix A.

II. THE SAMPLE

The sample used in this investigation consisted of 958 sets of examination scores drawn from a total student population of 26,111 writing the examination. Random selection was insured through the use of Fisher and Yates¹ table of random numbers. As Stuart has stated this

¹ Ronald A. Fisher and Frank Yates, Statistical Tables. (London: Oliver and Boyd, 1948), pp. 104-9.

procedure "is not the abdication of responsibility but the very reverse: we insure that no human inclination or prejudice will be allowed to endanger the bias free nature of the sample."²

Each of the 958 sets of scores consisted of the following four items:

- (a) the record of responses to the objective questions of Part I of the examination,
- (b) the principal's rating for Social Studies IX,
- (c) the total score and numerical and verbal sub-scores obtained on the School and College Ability Test,
- (d) the score obtained on Part II, the subjectively scored section of the examination.

The size of the sample was to some extent governed by considerations external to the study. The Examinations Branch wished to utilize the sample for statistical work and in the past had used a sample of this size. Although the size of the sample exceeded the minimum requirements of the statistical tests used, using the sample in its entirety was thought advisable. "The basic justification of statistical inference is that the distribution which is obtained from a random sample tends to resemble the population from which it is drawn. This tendency increases as the size of the sample increases."³

²A. Stuart, Basic Ideas of Scientific Sampling. (London: Charles Giffen and Company, Ltd., 1962), p. 11.

³Helen M. Walker and Joseph Lev, Elementary Statistical Methods. (New York: Holt, Rinehart, and Winston, 1958), p. 208.

III. CONSTRUCT VALIDITY

To determine whether evidence of a division or divisions existed among recall and higher mental process items or sets of items of the examination, tests of construct validity based on the hypotheses and assumptions of Chapter I were applied to the sample.

Identification of Items by Judges

Twelve judges, each working independently, identified each of the multiple choice items according to the six major categories of The Taxonomy. Each person chosen satisfied two criteria: (1) each was familiar with The Taxonomy and (2) each had recently taught or was currently engaged in teaching the Social Studies IX course.

These identifications were recorded. After each person had completed the identification of test items, he was interviewed as to the reason for his selections.

The proportion of agreement among the judges was summarized and then a comparison between the work of the judges and the initial item identification of the committee constructing the examination was made.

Factor Analysis

In assessing construct validity, the test investigator wishes to infer the degree to which the individual possesses some hypothetical trait or construct presumed to be reflected in the test performance. In this investigation, these are the subjectively identified ability levels of The Taxonomy.

Factor analysis was chosen as the statistical technique suited to

assessing the construct validity of the test. Guilford maintained that "the best answer to the question 'What does this test measure?' is in the form of a list of primary factors with which it correlates and their proportion of variance in the test."⁴ The above validity estimate is known as factorial validity. According to Guilford this type of validity is basic to the understanding of other kinds of validity and of many phenomena of correlation in general.

The Theory. Factor analysis assumes that, if two tests are administered to a group of individuals and the resulting scores indicate that there is a high correlation between the tests, the tests are measuring some underlying common factor or hypothetical variable. Positive correlations between a number of tests or test items indicate that one or more common factors are operating in the domain. Factor analysis provides a means for finding out information about these hypothetical variables.

The variance of a set of obtained scores for a test is composed of true variance, arising from individual differences of the subjects and error variance resulting from errors of measurement. When there is correlation between a number of measures some of the true variance will be common to two or more tests, and some of it will be specific to each. In factor analysis, it is the common variance which is of special interest. If a number of hypothetical variables less in number than the tests (in this case the test items and subtests) can be found to express the common variance and thus the common part of the test scores, then parsimony has

⁴J. P. Guilford, Fundamental Statistics in Psychology and Education. (4th ed.) New York: McGraw-Hill, 1965, p. 472.

been achieved. If, in addition, meaning can be given to these common factors, then an ordering of thinking about the domain under investigation can be achieved.

Mathematically, factor analysis is based on a linear model. The score Z_{ji} for an individual on a test is represented as a linear combination of hypothetical variables--

$$Z_{ji} = a_j/F/i + a_j^{2F2} i + a_{jm} F_{mi} + a_j U_{ji} :$$

--where Z_{ji} is the score of person i on test j in standard form, (with mean 0, and standard deviation 1) a_{jp} ($p = 1, 2....m$) is the factor loading, and expresses the correlation between tests j and factor p, F_{pi} is the factor score and describes the individual i in relation to factor p. U_{ji} ($i = 1, 2....N$) ($j = 1, 2....m$) are the unique factors; they describe the person i in relation to the unique part of j, a_j ($j = 1, 2....n$) is a factor loading expressing the correlation between test j and the unique factor corresponding to test j.

For a given person there are n values of z_{ji} , one for each of n tests, and there are N values of i, one for each of N individuals.

In order to gain information about a group of tests being analyzed, the problem consists of finding the values of the coefficients a_{jp} for the common factors.

To derive loadings or coefficients on factors in as many meaningful ways as possible in terms of The Taxonomy's process levels two approaches were used in grouping the test results for analysis.

Individual Item Analysis. The first approach involved factor analysis based on individual multiple choice items and somewhat paralleled

the methods with which Ayers⁵ experienced some success.

Tetrachoric correlations were calculated for the multiple choice items of Part I.

Tetrachoric correlation is appropriate to data arranged in a 2 x 2 or fourfold table. It assumes that both variables underlying the dichotomies are normally distributed. It has been used to provide a convenient measure of correlation when graduated measurements have been reduced to two categories. It is an estimate of product-moment correlation.

The standard error of r_t is always greater than the standard error of r . The magnitude of the error increases with the extremity of the dichotomies.

The procedure is quite acceptable when N is large.⁶

Factors from five to twenty-five in number were extracted from the correlation matrix thus derived, and rotated in order to find the most meaningful factorial arrangement.

Subtest Analysis. The second approach involved factor analysis based on item subtests and somewhat paralleled the methods with which Stoker and Kropp⁷ and Crawford⁸ did their research.

Items were divided into seven subtests on the basis of units of content. Then they were subdivided into knowledge item and higher mental process item subtests, resulting in the thirteen subtests as shown in Figure II.

Correlations were calculated for these subtests and from three to

⁵Ayers, op. cit.

⁶Guilford, op. cit., p. 244-6.

⁷Stoker and Kropp, op. cit.

⁸Crawford, op. cit.

	Geography Environment and Living	Industrial Expansion Labour and Business Organization	Development of American Culture	Democratic Government in Canada	Home and Community Living	Current Affairs	Inquiry
	(1)	(2)	(3)	(4)	(5)	(6)	
Knowledge Items	1	21	36 46	56	71	76	
	2	22	37 47	57	72	77	
	3	23	38 48	58	73	78	
	4	24	39	59		79	
	5		40	60		80	
	6	25	41	61		81	
		26	42	62		82	
		35	43	63			
			44				
			45				
Higher Mental Process Items	7	(8)	(9)	(10)	(11)	(12)	(13)
	17	27	49	64	74	83	91
	18	28	50	65	75	84	92
	19	29	51	66		85	93
	20	30	52	67		86	94
	10	31	53	68		87	95
	11						
	12	32	54	69		88	96
	13	33	55	70		89	97
	14	34					98
	15						99
	16						100

FIGURE II
ITEM SUBTESTS

five factors were extracted and rotated in order to find the most meaningful factorial arrangement by subtests.

IV. CONCURRENT VALIDITY

In order to investigate the concurrent validity of the test, the items of Part I were divided into two two-subtest groupings. Subtest 1A was composed of knowledge or recall items and subtest 1B was composed of questions designed to test the higher mental process. The classification reflected in subtests 1A and 1B were those of the committee which constructed the examination. Subtests 2A and 2B were similarly composed of knowledge and higher mental process questions with the classification here being that of the majority of the group of judges. These subtests were correlated with certain selected criteria.

External Criteria

Principal's ratings, Scholastic and College Ability Test Scores, and sub-scores from Part II, the subjective, essay section of the examination were chosen as external criteria. Each set of scores represented a distinct form of evaluation for grade IX students. All scores were obtained at the same time and under the same conditions as the subtests of Part I, previously mentioned.

Principal's Ratings. "These marks are often based on a combination of the teacher's estimate of student intelligence, maturation and classroom performance during the year."⁹ In many cases these marks are also

⁹Donald B. Black and Donald W. Knowles. "The Effectiveness of The Grade XII Principal's Rating Scores to predict Freshman Success in

influenced by the pupil's performance on final examination of the previous year. Black's study of 1958 revealed a .65¹⁰ correlation between the Departmental Mark in Social Studies IX and the Principals' Ratings. These ratings represent a teacher's professional assessment of pupil performance and are thought to have important implications for prediction and for the eventual accreditation of schools.

Co-operative School and College Ability Tests. Published by the Educational Testing Service, this test reflects a shift away from measuring "mental ability" to a greater concern with school learned abilities when one's aim is to predict school success. According to the manual the main purpose of the test is "to estimate the capacity of each individual student to undertake the academic work of the next higher level of schooling."¹¹ This test is divided into four parts. Parts I and III are concerned with "developed ability in skills that are closely related to student success in the verbal kinds of school learning."¹² Parts II and IV are "measures of ability in certain quantitative skills of number

9 (cont'd)

Four Faculties of The University of Alberta," The Alberta Journal of Educational Research XI: 128 No. 2.

¹⁰Donald B. Black and Donald W. Knowles. "A Study of The Relationship of The Grade IX Principal's Rating to Performance on the Alberta Grade IX Departmental Examinations," The Alberta Journal of Educational Research XIV: 227-238, 1958.

¹¹School and College Ability Tests, School Ability Tests, Manual for Interpreting Scores. (Princeton, New Jersey: Educational Testing Service, 1955), p. 3.

¹²Ibid.

manipulation and problem solving."¹³ Thus the test gives a verbal score and quantitative score and these may be combined to give a total score if desired. The items are all of the five response multiple-choice type.

The reviewers in The Fifth Mental Measurement Yearbook were generally agreed concerning the high quality of the construction of these tests. The reliability estimates given by the manual are .93 for the Verbal Score and .91 for the Quantitative Score.¹⁴ The publishers also gave evidence of the content and concurrent validity of the test in the manual and evidence of its predictive validity in a later supplement.

Part II Sub-Scores. Part II of the examination was of the sentence answer and short essay type. The sub-score obtained on this part of the examination comprised thirty per cent of the total mark. This sub-score was assigned by teachers marking the examination subjectively under the auspices of The Examination Branch of The Alberta Department of Education.

Intercorrelation

The subtests of Part I were correlated with the external criteria using Pearson's product-moment correlation. Use of the Pearson r is governed by a number of basic assumptions which could be met. The data used was scored on interval scales, could be expected to show normality of arrays, and the relationship of one set of scores to each other was rectilinear.

Other methods of correlation were considered but it was felt that

¹³Ibid.

¹⁴Ibid.

the Pearson r would provide the most accurate indication of the relationship being calculated.

To test Hypotheses B1 and B2 a test of significance was applied using the distribution of t where the t value required is given by the

formula:
$$t = r \frac{N-2}{\sqrt{1-r^2}}$$

To test Hypothesis B3 the significance of the difference in the correlation of item subtests with external criteria was calculated using the

formula:

$$t = \frac{(r_{12} - r_{13}) (N + 3) (1 + r_{23})}{\sqrt{2(1 - r_{12}^2 - r_{13}^2 - r_{23}^2 + 2r_{12}r_{13}r_{23})}}$$

Since this study proposed to investigate and report and recommend for further study rather than be a basis for direct action, all levels of significance were reported in the results.

To decide significance in correlations and differences in correlations an alpha level of .05 was set. Use of this significance level was justified on the following grounds. Choosing an α of .05 enlarges the possibility of Type II error; of accepting H_0 when in fact it is false; as opposed to using an α of .01 which enlarges the possibility of Type I error, rejecting H_0 when in fact it is true. Choosing .05 enlarges the chance of finding significance in this situation. As Seigel points out, "the level at which the researcher chooses to set alpha should be determined by his estimate of the importance of the practical significance

of his findings."¹⁵ This study will reflect on the possibility of further validating such tests and will not lead directly to action, thus, it was felt the alpha level of .05 would serve.

V. SUMMARY

All major statistical calculations for the study were made through use of programming and computer facilities available through the Faculty of Education's Research Services.

¹⁵ Sidney Seigel, Nonparametric Statistics for The Behavioural Sciences (New York: McGraw-Hill Book Company, 1956), p. 9.

CHAPTER IV

ANALYSIS AND RESULTS RELATED TO HYPOTHESES

I. CONSTRUCT VALIDITY

Hypothesis A1

A group of twelve judges, judging independently will reach agreement in classifying objective items of the test into knowledge and higher mental process categories.

Agreement Among Judges: Twelve judges reached unanimous agreement in identifying thirty-four test items, agreement with only one dissenting placement on fifteen items and majority (7 or more) agreement on an additional forty items. This made a total of eighty-nine items on which majority or better agreement was reached in identifying items according to the six major levels of The Taxonomy. For nine of the eleven items on which there was less than majority agreement, the judges showed disagreement only with respect to which of the higher mental processes the questions required. Hypothesis A1 was supported in that on only two of the one hundred items did the judges show less than majority agreement in placing an item in the knowledge or recall category as opposed to one of the higher mental process categories.

Agreement Between Judges and Committee: On the eighty-nine items on which the judges expressed majority or better agreement, sixty-four of these identifications agreed with the initial placement by the committee which designed the examination. For twenty-three of the twenty-five items

on which a majority of the judges disagreed with the initial placement, the judges placed the item at a lower process level than that set by the committee.

Eleven of the items had been given dual identifications by the committee; that is, the committee anticipated that students might answer the questions using one of two possible mental processes. For seven of these items a majority of the judges chose the lower of the two categories in terms of The Taxonomy. For the remaining four items a majority of the judges chose a level or category below the lower of the two alternatives given by the committee.

When the individual judges were interviewed with respect to their lack of agreement with the initial classification, two comments were recurrent. First, judges agreed that certain items could elicit responses at a higher level of thought than they had categorized the items as doing, but when they considered their knowledge of classroom situations and the manner in which students are taught they thought it unlikely. Second, they noted that in many cases, students could have used a process of eliminating distractors and arrived at the correct answer without having "thought through" the question in the manner intended.

The a priori classification of the judges for the items of Part I and the complete set of responses by the judges are recorded in Appendix C.

Hypotheses A2 and A3

(A2) The responses to the objective items classified in each Taxonomy category will correlate positively.

(A3) Factor analysis of correlation among items will result in higher mental process items loading on factors in a manner distinct from the loading of recall items.

As outlined in Chapter III factor analysis was used to examine the relationships among test items and subtests. "One method for checking out hypotheses of this sort is known as factor analysis. With the availability of modern computers, it provides a powerful and efficient means of testing out constructs that have presumably been built into tests."¹ The following is an explanation of the procedure of rotating factors used to arrive at the results of this part of the study and a description of the means of analysis used in arriving at the results that are reported.

Rotation of Factors. In factor analysis each test is represented by a point in a common factor space or by a line joining the origin to the point and called a test vector. The correlations between tests are determined by the angles between the test vectors, and the loadings of the tests on the factors are given by the perpendicular projections of the test vectors on the reference axis. So long as the test vectors are fixed, the relationships between the tests are not altered by rotating the reference axis about the origin but for every position of these axes there will be a different set of factor loadings. It can be seen that there will be an infinite number of solutions corresponding to all possible placements of the reference axis. The particular method of analysis places the axis in a certain position which may or may not have special

¹Dyer, op. cit., p. 40.

significance in terms of psychological meaning. The task of the investigator is then to rotate the reference axis in search of a solution which is meaningful in terms of the constructs being studied. In this study it was a case of arriving at a factorial arrangement meaningful in terms of a twofold division of constructs based in The Taxonomy.

Analysis: Factor analysis for both item and subtest arrangements consisted of utilizing a principal components method of analysis in which the factors are represented by the principal axes of ellipsoids formed through the plotting of scores on individual variables. The first principal factor accounts for the maximum possible variance and each successive one accounts for a maximum of the then existing residual variance.

From the principal factor solution three orthogonal rotations--equamax, quartimax, and varimax--based on the criteria of Harman² were performed. Because the factor pattern derived from rotation is dependent upon the number of factors entering the rotation, it was decided to iterate the rotations using five, eight, ten, and twenty-five factors for inter-item analysis and three and five factors for subtest analysis.

To further explore for the most meaningful arrangement of items and subtests an oblique rotational system, promax, was applied to the twenty-five factor varimax solution for items and the five-factor equamax solution for subtests. The promax solution used was based on the design of Henrickson and White.³ Basically it is a procedure for constructing the

²H. H. Harman. Modern Factor Analysis (Chicago: University of Chicago Press, 1960). Ch. 14.

³A. E. Henrickson and P. O. White. "Promax, A Quick Method for Rotation to Oblique Simple Structure," British Journal of Statistical Psychology, 1964, 17, pp. 65-70.

"best possible" oblique solution from an orthogonal rotation. It is designed to make the relationship in an orthogonal factor matrix clearer by increasing higher loadings on factors while decreasing smaller loadings.

Results of Inter-Item Factor Analysis: Hypotheses A2 and A3 were not supported by the results of factor analysis in that no clear interpretation could be made in terms of recall and higher mental process factor divisions.

Throughout the analysis a large number of the items loaded consistently high (.3 level and above) on one seemingly general factor. The percentage of the total variance accounted for by this factor was calculated to be forty per cent on the five factor principal factor solution. A large proportion of both the knowledge or recall and higher mental process items loaded on this first factor.

Examination of the remaining factors in the factorial arrangements did not produce any clear division of items in terms of a process dimension. Neither did the results produce clear content divisions among the items which could have been a basis for second-order factoring.

However, examination of the results obtained did show certain patterns in item loadings which were meaningful as a basis for discussing the inconclusiveness of the results and pointing out avenues for further research.

A number of items which were categorized as requiring the same mental process and had an outline somewhat independent of course content loaded heavily on the same factor. Test items 64 to 67 and Table I, taken from the promax solution shown in Appendix D, illustrate this pat-

tern. Items which were structured around a paragraph or some similar base tended to load together on certain factors.

Read the following paragraph taken from Canada and The Western World before answering items 64 to 67.

"The BNA Act is, in effect, the written part of the constitution of Canada, but there is a vast part of our constitution that is unwritten and has just developed through custom. One example of this is the way in which bills are introduced into parliament and what happens to them before they become law."

Examine each statement below and on the answer sheet mark:

- A. if the statement involves the BNA Act.
- B. if the statement involves parliamentary procedure or the unwritten constitution of Canada.
- C. if the statement involves neither of the above.

John Adams, an opposition member from White County , P. E. I., introduced a bill into the House of Commons stating that a program for research that will lead to potato seed improvement be sponsored by the government of Canada.

64. A government member from Saskatchewan claims Adams is out of order.

65. A member from Ontario thinks that it is a good idea.

66. A member from B. C. claims this is a matter for P. E. I.'s provincial government.

A number of other items which dealt with distinctly different areas

TABLE I
SELECTED FACTOR LOADINGS FOR
ITEMS SIXTY-FOUR TO SIXTY-SEVEN

Item Number	Item Category	Factor Loadings Above .3 Level
		(5)
64	3.00-4.00	6838
65	3.00-4.00	6962
66	3.00-4.00	6834
67	3.00-4.00	6058

of content but were categorized as requiring the same thought process loaded together on the same factors. Items 35 and 36 and Table II illustrate this pattern.

Under the provision of "The Alberta Labour Act" a Conciliation Commissioner was appointed to settle a dispute between an employer and a labour union over wages. A Conciliation Board was later appointed. The Conciliation Board's award led to a lockout.

35. It can be stated that the lock-out was

- A. illegal because collective bargaining did not take place.
- B. illegal because the Conciliation Commissioner failed to perform all his duties.
- C. legal because the award favoured the employers.
- D. legal because either side may reject an award of a Conciliation Board.

36. Canada is to Metis as Latin America is to

- A. Aztec
- B. Cree
- C. Iroquois
- D. Mestizo

Another number of items which differed widely in categorization as to the thought process required but which required knowledge of the same content loaded upon the same factor. Items 82 and 85 with Table III illustrate this pattern.

82. In an attempt to make Rhodesia relax its stand on Negro representation in government all the following pressures have been imposed EXCEPT--

- A. military
- B. diplomatic
- C. press
- D. economic

85. I. The number of votes in the General Assembly is granted on the basis of the population of a nation.

II. The African Asian lands form the largest block in the world organization when they agree to vote together for a particular purpose.

(On Item 85 students were required to indicate the degree of truth or untruth of this combination of statements.)

It was also noted that certain items categorized as requiring the same thought process and sampling the same narrow area of content showed widely differing factor patterns. This situation was not common but did

TABLE II
SELECTED FACTOR LOADINGS ON
ITEMS THIRTY-FIVE AND THIRTY-SIX

Item Number	Item Category	Factor Loadings Above .3 Level			
		(2)	(3)	(4)	(5)
35	1.25	4157	5063	3269	3827
36	1.20	3123	4493	4224	3513

TABLE III
 SELECTED FACTOR LOADINGS ON
 ITEMS EIGHTY-TWO AND EIGHTY-FIVE

Item Number	Item Category	Factor Loadings Above .3 Level			
		1)	(2)	(3)	(13)
82	1.10	3232	4058	4850	4894
85	4.20	4643	4519	3118	4208

occur with respect to three of four item combinations. Items 2 and 3 and Table IV illustrate this lack of relationship.

2. The most extensive railway system in Latin America is found in:

- A. Argentina
- B. Brazil
- C. Chile
- D. Uruguay

3. The most industrialized country in South America is:

- A. Argentina
- B. Brazil
- C. Colombia
- D. Venezuela

Most of the individual items showed factor loadings that could be classified as following one of the first three patterns.

Results of Subtest Factor Analysis: Hypotheses A2 and A3, as in the case of inter-item analysis, were not supported by factor analysis of groups of items which were homogeneous as to the content area they were intended to sample.

One major factor accounted for a large proportion of the variance --forty per cent in the case of the unrotated factor matrix for five factors. Nine of the thirteen subtest variables loaded consistently on this major, seemingly general factor.

Four of the subtests loaded heavily on other factors. In the case of the Quartimax solution for five factors shown in Table V, these subtests with loadings all in excess of .7 served to define the remaining

TABLE IV
 SELECTED FACTOR LOADINGS ON
 ITEMS TWO AND THREE

Item Number	Item Category	Factor Loadings Above .3 Level	
		(1)	(22)
2	1.12	—	6959
3	1.12	5589	—

TABLE V
QUARTIMAX FACTOR SOLUTION FOR SUBTESTS

Subtests		Factor Loadings				
		(1)	(2)	(3)	(4)	(5)
1.	Knowledge Items--Geography Environment and Living	492	-024	-021	065	<u>779</u>
2.	Knowledge Items--Industrial Expansion, Labour and Business	744	-052	053	068	-189
3.	Knowledge Items--Development of American Culture	765	-009	071	050	187
4.	Knowledge Items--Democratic Government in Canada	768	051	008	-114	078
5.	Knowledge Items--Home and Community Living	244	<u>958</u>	018	032	-016
6.	Knowledge Items-- Current Affairs	723	029	-069	-099	024
7.	HMP Items--Geography Environment and Living	749	019	-060	-015	183
8.	HMP Items--Industrial Expansion, Labour and Business	724	129	-079	043	-224
9.	HMP Items--Development of American Culture	355	038	-003	<u>907</u>	051
10.	HMP Items--Democratic Government in Canada	653	-093	052	145	-092
11.	HMP Items--Home and Community Living	342	018	<u>919</u>	-005	-012
12.	HMP Items-- Current Affairs	678	081	053	-020	190
13.	HMP Items-- Inquiry	633	038	189	126	-014

factors. However, these subtests could not be grouped as either knowledge of higher mental process subtests, two being from each process grouping.

Other factor rotations, including an oblique solution based on promax, did not substantially alter this pattern for the subtests.

II. CONCURRENT VALIDITY

Hypotheses B1 and B2

(B1) A positive correlation will be obtained between scores on objective test items identified as requiring only recall and the following external criteria:

- A. SCAT Total Scores
- B. SCAT Verbal Sub-Scores
- C. SCAT Quantitative Sub-Scores
- D. Principal Ratings
- E. Examination Sub-Scores, from the Essay Section,
Part II of The Examination

(B2) A positive correlation will be obtained between scores on objective test identified as requiring higher mental processes and the criteria presented under B1 above.

Hypotheses B1 and B2 were supported in all cases at the .01 level of significance. Table VI shows the correlation coefficients obtained between the knowledge and higher mental process subtests and the external criteria. The support given these hypotheses provided a basis for Hypothesis B3 which related directly to the concurrent validity of the test.

TABLE VI

CORRELATION OF KNOWLEDGE AND HIGHER MENTAL PROCESS
SUBTESTS WITH EXTERNAL CRITERIA

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Part I - 100 Item Total	949	919	934	944	746	595	759	719	703
2. Knowledge Item Subtest (1A)		787	973	857	707	571	723	728	685
3. Higher Mental Process Item Subtest (1B)			798	968	729	560	731	640	605
4. Knowledge Item Subtest (2A)				814	714	565	725	725	680
5. Higher Mental Process Item Subtest (2B)					729	574	737	645	612
6. SCAT Verbal Subscore						550	894	640	625
7. SCAT Quantitative Subscore							832	592	524
8. SCAT Total Score								687	640
9. Principal's Ratings									638
10. Part II Score									
Means	56.75	30.46	26.51	26.77	30.21	40.14	34.66	74.57	58.33
Standard Deviations	15.02	8.70	6.92	7.32	8.19	9.95	8.63	16.41	14.69
									6.37

Hypothesis B3

Correlations obtained while testing Hypothesis B1 will differ significantly from correlations obtained while testing Hypothesis B2.

The results of testing Hypothesis B3 are reported as they relate to each of the external criteria. Table VII provides a summary of these results.

SCAT Scores: Hypothesis B3 was not supported at the .05 level of significance for SCAT verbal, quantitative and total scores in both the Committees' and Judges classification of items. Although the verbal and total scores correlated more highly with higher mental process subtests, the difference was not statistically significant.

Principal's Ratings: Hypothesis B3 was supported at the .05 level of significance in both the committee's and judges' classification of items and their relationship to The Principal's Ratings. Knowledge item subtests correlated significantly higher with Principal's Ratings than higher mental process item subtests.

Part II Scores: Hypothesis B3 was supported at the .05 level of significance for the committees' subtests and Part II Scores. For the judges classification the significance was very near the .05 level. In all cases the knowledge subtests correlated more highly with the Part II scores than the higher mental process subtests.

TABLE VII
SIGNIFICANCE OF DIFFERENCES IN CORRELATION BETWEEN
KNOWLEDGE AND HIGHER MENTAL PROCESS SUBTESTS
IN RELATION TO EXTERNAL CRITERIA

	SCAT VERBAL	SCAT QUANTITATIVE	SCAT TOTAL	PRINCIPAL'S PART II RATINGS	
	(6)	(7)	(8)	(9)	(10)
2 Knowledge Item Subtest (1A)	707	571	723	728	685
3 Higher Mental Process Item Subtest (1B)	729	560	731	640	605
Level of Significance	.3	.3	.3	.05*	.05*
4 Knowledge Item Subtest (2A)	714	565	725	725	680
5 Higher Mental Process Item Subtest (2B)	729	574	737	645	612
Level of Significance	.3	.3	.3	.05*	.1

*

Significant in relation to Hypothesis B3

CHAPTER V

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

I. SUMMARY

The purpose of this study was to attempt to find evidence that Part I of the 1966 Grade Nine Departmental Examination in Social Studies did require the use of intellectual abilities and skills in a manner distinct from the ability to recall factual material. Specifically, the relationship between knowledge items and higher mental process items, individually and in groups, was examined using tests of construct and concurrent validity.

The main findings of the investigation may be summarized as follows:

1. Individual judges showed a high proportion of agreement in classifying the multiple choice items of Part I of the examination according to the major levels of The Taxonomy. With the exception of two items they distinguished between recall and higher mental process items.
2. Judges showed considerable agreement with the initial classification of the items. However, in a number of cases the judges showed a tendency to classify items at a lower level than that originally set by the committee constructing the examination.
3. Factor analysis conducted on Part I, both by individual items and by subtests, revealed a large general factor which accounted for a large proportion of the score variance.

4. Factor analysis revealed no clear evidence that the test did distinguish between recall and higher mental abilities. It seemed that a number of uncontrolled variables, particularly a content relationship, interfered with a clear interpretation of results.
5. Factor analysis did reveal that questions which appeared to be carefully structured and did not relate directly to course content did tend to load uniformly on certain factors.
6. Subtests of knowledge or recall items correlated significantly higher with Principal's Ratings and Part II scores than did subtests composed of higher mental process items.
7. Subtests of knowledge or recall items and subtests of higher mental process items did not show a significant difference in correlations with SCAT scores, although a tendency for the verbal subscore of the SCAT test to correlate more highly with the higher mental process subtests was evident.

II. CONCLUSIONS AND IMPLICATIONS

It is convenient to group the contents of this section under two headings, corresponding to the two groups of hypotheses.

Construct Validity

It would appear that when The Taxonomy serves as a basis for constructing items to measure the behaviour described therein, judges can assign the items to appropriate categories with some accuracy. Lack of agreement, when it occurs among themselves, or with the a priori

classification can seemingly be ascribed to at least the following two reasons, both of which have a common basis in that the item writer and item judge have different conceptions of the competencies and problem solving methods used by students for whom the items were intended. First the item writers might have prepared an item for an upper level of The Taxonomy and the rater believed the student will know the answer to the item because of prior knowledge, as reflected in the downward trend in the judges identifying of test items. Second, the item writers might have prepared an item to evoke behaviours regarded as "evaluation", but the student might have answered the question by systematically eliminating distractors or some other method. Thus, the intended process differed from the obtained process.

Identification by judges was of no empirical significance, being very subjective in nature, but it did provide an assessment of the initial classification on which later statistical analysis was based.

As other studies have shown, factor analysis revealed a large or major factor which could be interpreted as being one representing general competence and mastery of course content. Further interpretation of these results in a meaningful and comprehensive manner was impossible due, it would seem, to several other variables affecting the factor patterns.

A content variable was thought to be a major source of the interference. The test sampled a wide area of content and consequently student familiarity with and competence on each question would differ according to his interest in and mastery of each content area.

A "teaching" or instructional variable was thought to be another

source of interference. Teachers would probably teach students to approach questions in ways unanticipated by the item writers. In this type of testing situation there is no appraisal of the way in which an answer is derived.

Also contributing to the inconclusiveness of the test results was probably the overall heterogeneity of the testing situation.

Results did suggest, however, that in cases where the item was intended to evoke higher mental processes and the content base was structured independent of course content, then evidence of some "higher" intellectual process could be recognized.

Concurrent Validity

Empirical evidence in support of concurrent validity indicated that knowledge items did require a type or level of ability different from that of higher mental process items.

However, since the construct validity of the test was not proven in this regard it can not be definitely stated what factor accounted for this difference in relating to external criteria. It may be that the knowledge or recall items were much more closely allied to course content in design than were the higher mental process items or it may be that different abilities were actually required or a combination of factors could have been operating.

Evidence would also seem to indicate that the teachers' evaluation of their students both in the form of a general rating and in the form of essay and paragraph marks is allied more closely with the recall form of examination.

III. SUGGESTIONS FOR FURTHER RESEARCH

While not supporting the hypotheses and answering conclusively the basic problem of the study, the results did point out several possibilities for further constructive research.

This study has shown something of the complexity of evaluating a process dimension of learning in a mass testing situation. Further research is needed both in the selection of examination questions and in the analysis of examination results. There is a possibility that the utilization of sophisticated item selection technique such as that developed by Wahlstrom¹ and the application of new techniques of factor analysis such as that developed by Hendrickson and White² would allow for meaningful interpretation of large scale examination results in terms of the levels of The Taxonomy.

Results of factor analysis suggested that several variables need to be studied and controlled if intellectual abilities and skills are to be assessed. To validate The Taxonomy there is a need for more studies in which the teaching technique is known and controlled, the content area strictly limited, and the testing instrument carefully constructed. Studies of this nature will be needed in all subject areas as a basis for applying The Taxonomy with clarity and meaningfulness to large scale testing situations.

¹Merlin E. Wahlstrom "A Factor Analytic Technique for Item Selection." (unpublished Ph. D. Thesis, The University of Alberta, 1967).

²Alan E. Hendrickson and Paul D. White. "A Method for the Rotation of Higher Order Factors." The British Journal of Mathematical and Statistical Psychology (Vol. XIX, Part I; 1966).

The responses of the judges and the results of factor analysis and intercorrelation imply the need for study of the actual learning situation which test results are intended to reflect. Taba³ has, among others, pointed out that tests and test results should be part of a complete and well planned process. If intellectual abilities and skills are to be assessed then the teaching must show such evidence that it provides for the acquisition of these abilities and skills.

Further study is needed of the predictive qualities of examinations intended to assess higher mental processes and their interrelationship with other forms of evaluation. There is an evident difference in the relationship of knowledge and higher mental process questions to other evaluative criteria but the reasons for this difference are not known. Do teachers conceive of student ability in terms of their ability to master content and recall material? Do written examinations require the utilization of intellectual abilities and skills and are these actually assessed in the evaluation procedures used? What is the actual relationship of standardized tests to external subject area examinations? All these questions need reappraisal in terms of the entry of a process dimension into testing based on The Taxonomy.

The use of The Taxonomy as developed by Bloom and his associates has brought a general consciousness of the need to study the whole problem of assessing objective attainment in the social studies and in particular to study the problem of developing and evaluating intellectual

³Hilda Taba and Deborah Elkins. Teaching Strategies for The Culturally Disadvantaged. (Chicago: Rand McNally and Company, 1966).

abilities and skills other than recall. Present testing procedures do not allow for a statistical verification of this dimension but the results of this study suggest the problems are not with the theory itself but with the implementation of the theory in a mass testing situation. Further research of the type mentioned would serve to eliminate these problems.

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APPENDIX A
CONDENSED VERSION OF THE TAXONOMY
OF EDUCATIONAL OBJECTIVES

COGNITIVE DOMAIN

KNOWLEDGE

1.00 KNOWLEDGE

Knowledge, as defined here, involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting. For measurement purposes, the recall situation involves little more than bringing to mind the appropriate material. Although some alteration of the material may be required, this is a relatively minor part of the task. The knowledge objectives emphasize most the psychological processes of remembering. The process of relating is also involved in that a knowledge test situation requires the organization and reorganization of a problem such that it will furnish the appropriate signals and cues for the information and knowledge the individual possesses. To use an analogy, if one thinks of the mind as a file, the problem in a knowledge test situation is that of finding in the problem or task the appropriate signals, cues, and clues which will most effectively bring out whatever knowledge is filed or stored.

1.10 KNOWLEDGE OF SPECIFICS

The recall of specific and isolable bits of information. The emphasis is on symbols with concrete referents. This material, which is at a very low level of abstraction, may be thought of as the elements from which more complex and abstract forms of know-

ledge are built.

1.11 KNOWLEDGE OF TERMINOLOGY

Knowledge of the referents for specific symbols (verbal and non-verbal). This may include knowledge of the most generally accepted symbol referent, knowledge of the variety of symbols which may be used for a single referent, or knowledge of the referent most appropriate to a given use of a symbol.

*To define technical terms by giving their attributes, properties, or relations.

*Familiarity with a large number of words in their common range of meanings.

1.12 KNOWLEDGE OF SPECIFIC FACTS

Knowledge of dates, events, persons, places, etc. This may include very precise and specific information such as the specific date or exact magnitude of a phenomenon. It may also include approximate or relative information such as an approximate time period or the general order of magnitude of a phenomenon

*The recall of major facts about particular cultures.

*The possession of a minimum knowledge about the organisms studied in the laboratory.

1.20 KNOWLEDGE OF WAYS AND MEANS OF DEALING WITH SPECIFICS

Knowledge of the ways of organizing, studying, judging and criticizing. This includes the methods of inquiry, the chronological sequences, and the standards of judgment within a field as well

as the patterns of organization through which the areas of the fields themselves are determined and internally organized. This knowledge is at an intermediate level of abstraction between specific knowledge on the one hand and knowledge of universals on the other. It does not so much demand the activity of the student in using the materials as it does a more passive awareness of their nature.

1.21 KNOWLEDGE OF CONVENTIONS

Knowledge of characteristic ways of treating and presenting ideas and phenomena. For purposes of communication and consistency, workers in a field employ usages, styles, practices, and forms which best suit their purposes and/or which appear to suit best the phenomena with which they deal. It should be recognized that although these forms and conventions are likely to be set up on arbitrary, accidental, or authoritative bases, they are retained because of the general agreement or concurrence of individuals concerned with the subject, phenomena, or problem.

*Familiarity with the forms and conventions of the major types of works, e.g., verse, plays, scientific papers, etc.

*To make pupils conscious of correct form and usage in speech and writing.

1.22 KNOWLEDGE OF TRENDS AND SEQUENCES

Knowledge of the processes, directions, and movements of phenomena with respect to time.

*Understanding the continuity and development of American culture as exemplified in American Life.

*Knowledge of the basic trends underlying the development of public assistance programs.

1.23 KNOWLEDGE OF CLASSIFICATIONS AND CATEGORIES

Knowledge of the classes, sets, division, and arrangements which are regarded as fundamental for a given subject field, purpose, argument, or problem.

*To recognize the area encompassed by various kinds of problems or materials.

*Becoming familiar with a range of types of literature.

1.24 KNOWLEDGE OF CRITERIA

Knowledge of the criteria by which facts, principles, opinions, and conduct are tested or judged.

*Familiarity with criteria for judgment appropriate to the type of work and the purpose for which it is read.

*Knowledge of criteria for the evaluation of recreational activities.

1.25 KNOWLEDGE OF METHODOLOGY

Knowledge of the methods of inquiry, techniques, and procedures employed in a particular subject field as well as those employed in investigating particular problems and phenomena. The emphasis here is on the individual's knowledge of the method.

*Knowledge of scientific methods for evaluating health concepts.

*The student shall know the methods of attack relevant to the kinds of problems of concern to the social sciences.

1.30 KNOWLEDGE OF THE UNIVERSALS AND ABSTRACTIONS IN A FIELD

Knowledge of the major schemes and patterns by which phenomena and ideas are organized. These are the large structures, theories, and generalizations which dominate a subject field or which are quite generally used in studying phenomena or solving problems. These are at the highest levels of abstraction and complexity.

1.31 KNOWLEDGE OF PRINCIPLES AND GENERALIZATIONS

Knowledge of particular abstractions which summarize observations of phenomena. These are the abstractions which are of value in explaining, describing, predicting, or in determining the most appropriate and relevant action or direction to be taken.

*Knowledge of the important principles by which our experience with biological phenomena is summarized.

*The recall of major generalizations about particular cultures.

1.32 KNOWLEDGE OF THEORIES AND STRUCTURES

Knowledge of the Body of principles and generalizations together with their interrelations which present a clear, rounded, and systematic view of a complex phenomenon, problem, or field. These

are the most abstract formulations, and they can be used to show the interrelation and organization of a great range of specifics.

*The recall of major theories about particular cultures.

*Knowledge of a relatively complete formulation of the theory of evolution.

HIGHER MENTAL PROCESSES

Abilities and skills refer to organized modes of operation and generalized techniques for dealing with materials and problems. The materials and problems maybe of such a nature that little or no specialized and technical information is required. Such information as is required can be assumed to be part of the individual's general fund of knowledge. Other problems may require specialized and technical information at a rather high level such that specific knowledge and skill in dealing with the problem and the materials are required. The abilities and skill objectives emphasize the mental processes of organizing and reorganizing material to achieve a particular purpose. The materials may be given or remembered.

2.00 COMPREHENSION

This represents the lowest level of understanding. It refers to a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

2.10 TRANSLATION

Comprehension as evidenced by the care and accuracy with which the communication is paraphrased or rendered from one language or form of communication to another. Translation is judged on the basis of faithfulness and accuracy, that is, on the extent to which the material in the original communication is preserved although the form of the communication has been altered.

*The ability to understand non-literal statements (metaphor, symbolism, irony, exaggeration).

*Skill in translating mathematical verbal material into symbolic statements and vice versa.

2.20 INTERPRETATION

The explanation or summarization of a communication. Whereas translation involves an objective part-for-part rendering of a communication, interpretation involves a reordering, rearrangement, or a new view of the material.

*The ability to grasp the thought of the work as a whole at any desired level of generality.

*The ability to interpret various types of social data.

2.30 EXTRAPOLATION

The extension of trends or tendencies beyond the given data to determine implications, consequences, corollaries, effects, etc., which are in accordance with the conditions described in the original communication.

*The ability to deal with the conclusions of a work in terms of the immediate inference made from the explicit statements.

*Skills in predicting continuation of trends.

3.00 APPLICATION

The use of abstractions in particular and concrete situations. The abstractions may be in the form of general ideas, rules of procedures, or generalized methods. The abstractions may also be technical principles, ideas, and theories which must be remembered and applied.

*Application to the phenomena discussed in one paper of the scientific terms or concepts used in other papers.

*The ability to predict the probable effect of a change in a factor on a biological situation previously at equilibrium.

4.00 ANALYSIS

The breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit. Such analyses are intended to clarify the communication, to indicate how the communication is organized, and the way in which it manages to convey its effects, as well as its basis and arrangement.

4.10 ANALYSIS OF ELEMENTS

Identification of the elements included in a communication.

*The ability to recognize unstated assumptions.

*Skills in distinguishing facts from hypotheses.

4.20 ANALYSES OF RELATIONSHIPS

The connections and interactions between elements and parts of a communication.

*Ability to check the consistency of hypotheses with given information and assumptions.

*Skills in comprehending the interrelationships among the ideas in a passage.

4.30 ANALYSIS OF ORGANIZATIONAL PRINCIPLES

The organization, systematic arrangement, and structure which hold the communication together. This includes the "explicit" as well as "implicit" structure. It includes the bases, necessary arrangement, and the mechanics which make the communication a unit.

*The ability to recognize form and pattern in literary or artistic works as a means of understanding their meaning.

*Ability to recognize the general techniques used in persuasive materials, such as advertising, propaganda, etc.

5.00 SYNTHESIS

The putting together of elements and parts so as to form a whole. This involves the process of working with pieces, parts,

elements, etc., and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before.

5.10 PRODUCTION OF A UNIQUE COMMUNICATION

The development of a communication in which the writer or speaker attempts to convey ideas, feelings, and/or experiences to others.

*Skill in writing, using an excellent organization of ideas and statements.

*Ability to tell a personal experience effectively.

5.20 PRODUCTION OF A PLAN, OR PROPOSED SET OF OPERATIONS

The development of a plan of work or the proposal of a plan of operations. The plan should satisfy requirements of the task which may be given to the student or which he may develop himself.

*Ability to propose ways of testing hypotheses.

*Ability to plan a unit of instruction for a particular teaching situation.

5.30 DERIVATION OF A SET OF ABSTRACT RELATIONS

The development of a set of abstract relations either to classify or explain particular data or phenomena, or the deduction of propositions and relations from a set of basic propositions or symbolic representations.

*Ability to formulate appropriate hypotheses based upon an analysis of factors involved, and to modify such hypotheses in the light of new factors and considerations.

*Ability to make mathematical discoveries and generalizations.

6.00 EVALUATION

Judgments about the value of material and methods for given purposes. Quantitative and qualitative judgments about the extent to which material and methods satisfy criteria. Use of a standard of appraisal. The criteria may be those determined by the student or those which are given to him.

6.10 JUDGMENTS IN TERMS OF INTERNAL EVIDENCE

Evaluation of the accuracy of a communication from such evidence as logical accuracy, consistency, and other internal criteria.

*Judging by internal standards, the ability to assess general probability of accuracy in reporting facts from the care given to exactness of statement, documentation, proof, etc.

*The ability to indicate logical fallacies in arguments.

6.20 JUDGMENTS IN TERMS OF EXTERNAL CRITERIA

Evaluation of material with reference to selected or remembered criteria.

*The comparison of major theories, generalizations, and facts about particular cultures.

*Judging by external standards, the ability to compare a work with the highest known standards in its field--especially with other works of recognized excellence.

APPENDIX B
TAXONOMY LEVELS, BISERIAL CORRELATIONS
AND DIFFICULTY LEVELS FOR ITEMS OF
PART I.

Item No.	TL	BC	Diff	Item No.	TL	BC	Diff
1	1.20	472	53	41	1.12	439	68
2	1.12	222	47	42	1.10	501	73
3	1.12	382	59	43	1.22	634	74
4	1.10	500	66	44	1.12	419	53
5	1.10	307	65	45	1.22	539	57
6	1.10	403	80	46	1.22	567	70
7	2.20	098	35	47	1.22	416	48
8	3.00	228	54	48	1.10	475	56
9	3.00	409	68	49	2.20	407	32
10	2.20	417	72	50	4.20	321	58
11	2.20	472	56	51	4.20	298	62
12	3.00	430	69	52	4.20	350	70
13	3.00	585	60	53	2.20	139	40
14	3.00	446	41	54	2.20	174	44
15	2.20	362	60	55	2.20	220	28
16	2.20	380	78	56	1.22	427	61
17	2.20	528	64	57	1.22	510	60
18	2.20	573	51	58	1.10	572	55
19	2.20	028	12	59	1.10	434	53
20	2.20	674	52	60	1.10	504	77
21	1.22-4.20	281	52	61	1.10	471	77
22	1.25-4.00	613	51	62	1.20	663	78
23	1.20	521	73	63	1.31-2.1	518	60
24	1.20	485	42	64	3.00-4.00	378	55
25	1.20	393	57	65	3.00-4.00	393	53
26	1.22	438	47	66	3.00-4.00	474	45
27	2.20-3.00	483	86	67	3.00-4.00	433	55
28	2.00	254	57	68	4.00	380	65
29	2.00-4.00	536	46	69	4.00	454	55
30	2.00-4.00	457	64	70	4.00	534	60
31	2.00-4.00	218	67	71	2.20	437	88
32	3.00	339	75	72	2.20	205	66
33	2.30	528	40	73	2.20	417	41
34	2.20	593	49	74	2.10	304	26
35	1.25	484	78	75	2.30	281	47
36	1.20	569	79	76	1.10	432	89
37	1.00	152	70	77	1.10	347	58
38	1.10	545	70	78	1.12	574	70
39	1.12	500	72	79	1.12	568	73
40	1.12	535	73	80	1.10	482	89

Item No.	TL	BC	Diff	Item No.	TL	BC	Diff
81	1.10	349	23	91	2.00	490	68
82	1.10	587	46	92	4.00	060	67
83	4.20	500	46	93	4.00	458	60
84	4.20	487	64	94	4.00	587	93
85	4.20	549	53	95	4.00	497	65
86	4.20	441	27	96	6.00	338	59
87	2.00	470	24	97	6.00	333	32
88	2.00	023	13	98	6.00	439	22
89	2.00	510	66	99	6.00	534	60
90	2.00	---	---*	100	6.00	312	32

*Item 90 was eliminated from the test and did not figure in the results.

APPENDIX C
ITEM IDENTIFICATION BY JUDGES

Item No.	Committee TL	Judges - Bloom's Levels					
		1	2	3	4	5	6
1	1.20	12					
2	1.12	12					
3	1.12	12					
4	1.10	12					
5	1.10	12					
6	1.10	12					
7	2.20	4	4	4			
8	3.00		2	10			
9	3.00		1	11			
10	2.20		2	10			
11	2.20		1	10	1		
12	3.00			10	2		
13	3.00	1	4	7			
14	3.00		2	9	1		
15	2.20	12					
16	2.20	7	5				
17	2.20	12					
18	2.20	12					
19	2.20	12					
20	2.20	12					
21	1.22-4.20	12					
22	1.25-4.00	9	3				
23	1.20	11	1				
24	1.20	10	2				
25	1.20	11	1				
26	1.22	6	5	1			
27	2.20-3.00	3	9				
28	3.00	1	2	9			
29	2.00-4.00	2	10				
30	2.00-4.00	2	10				
31	2.00-4.00	1	10	1			
32	3.00	1	9		1	1	
33	2.30		9	2	1		
34	2.20		10		2		
35	1.25	1	9		2		

Item No.	Committee TL	Judges - Bloom's Levels					6
		1	2	3	4	5	
36	1.20	9	1	1	1		
37	1.00	12					
38	1.10	12					
39	1.12	10	1	1			
40	1.12	12					
41	1.12	12					
42	1.10	12					
43	1.22	10	2				
44	1.12	12					
45	1.22	9	3				
46	1.22	11	1				
47	1.22	12					
48	1.10	12					
49	2.20	11	1				
50	4.20		7		5		
51	4.20		7		5		
52	4.20		7		5		
53	2.20	1	11				
54	2.20		11		1		
55	2.20		11		1		
56	1.22	12					
57	1.22	12					
58	1.10	12					
59	1.10	12					
60	1.10	12					
61	1.10	12					
62	1.20	12					
63	1.31-2.10	9	3				
64	3.00-4.00			9	3		
65	3.00-4.00			9	3		
66	3.00-4.00			9	3		
67	3.00-4.00			9	3		
68	4.00		10		2		
69	4.00	1	8	1	2		
70	4.00		8		4		

Item No.	Committee TL	Judges - Bloom's Levels					6
		1	2	3	4	5	
71	2.20		11		1		
72	2.20		11		1		
73	2.20		11		1		
74	2.10	9	2	1			
75	2.30	10	1	1			
76	1.10	12					
77	1.10	12					
78	1.12	12					
79	1.12	12					
80	1.10	12					
81	1.10	12					
82	1.10	12					
83	4.20	11			1		
84	4.20	11			1		
85	4.20	11			1		
86	4.20	11			1		
87	2.00		9	1			2
88	2.00		9	1			2
89	2.00		9	1		1	1
90	2.00		9	1		1	1
91	2.00		9	2		1	
92	4.00		3	3	2	2	2
93	4.00		3	3	2	2	2
94	4.00		3	3	2	2	2
95	6.00	1		4	2		5
96	6.00	1		4	2		5
97	6.00		2	3	3		4
98	6.00	1		2	4		5
99	6.00	1	2	2	4		3
100	6.00		4	4	2		2

APPENDIX D

FACTOR STRUCTURE ON THE PRIMARY 3 FOR
TWENTY-FIVE FACTORS AND NINETY-NINE VARIABLES

	1	2	3	4	5	6	7	8	9	10
1	1.0000	0.4073	0.5132	0.3589	0.4351	0.4671	0.3483	0.1569	0.3762	0.2467
2	0.4073	1.0000	0.5659	0.3737	0.4541	0.4807	0.2974	0.1160	0.5270	0.3755
3	0.5132	0.5659	1.0000	0.3951	0.4691	0.5254	0.3572	0.0425	0.5768	0.3448
4	0.3589	0.3737	0.3951	1.0000	0.3569	0.2883	0.2895	-0.0055	0.3365	0.2611
5	0.4351	0.4541	0.4691	0.3569	1.0000	0.4203	0.3053	-0.0005	0.4283	0.2341
6	0.4671	0.4807	0.5254	0.2883	0.4203	1.0000	0.2269	0.0317	0.4879	0.3977
7	0.3483	0.2974	0.3572	0.2895	0.3053	0.2269	1.0000	0.1732	0.2661	0.4146
8	0.1569	0.1160	0.0425	-0.0055	-0.0005	-0.0317	0.1732	1.0000	-0.0251	0.0079
9	0.3762	0.5270	0.5768	0.3365	0.4283	0.4879	0.2661	-0.0251	1.0000	0.2519
10	0.2467	0.3755	0.3448	0.2611	0.2341	0.3977	0.4146	0.0079	0.2519	1.0000
11	0.2432	0.0920	0.1911	0.2559	0.0406	-0.0536	0.5556	0.1564	0.1193	-0.0438
12	0.1591	0.3542	0.3028	0.1441	0.1927	0.2374	0.1510	0.1682	0.2710	0.2518
13	0.3578	0.3749	0.3992	0.2620	0.2236	0.2634	0.4087	0.0756	0.3043	0.3239
14	0.2264	0.1380	0.0937	0.0209	0.1444	0.1764	0.2987	0.1437	0.1237	0.2318
15	0.0319	0.1910	0.1080	0.1152	0.0930	-0.0781	0.1876	0.0826	0.0849	-0.0044
16	0.2252	0.2092	0.2928	0.0437	0.1659	0.3472	0.3472	-0.0473	0.1727	0.3755
17	0.0839	0.0532	0.0566	0.1935	0.0604	0.1243	-0.1464	-0.1482	0.1255	-0.1291
18	0.2575	0.2006	0.2560	0.1243	0.2347	0.1144	0.1144	0.0541	0.2842	0.1101
19	0.1051	0.1255	0.0515	0.2038	0.0159	0.1876	0.1876	0.2038	-0.0159	0.0334
20	0.0515	0.0515	0.0515	0.1673	0.1673	0.2181	0.2181	0.1673	-0.2286	-0.0293
21	0.1373	0.1373	0.1373	0.0946	0.0946	0.0016	-0.0016	0.0946	-0.1253	0.0748
22	0.0164	0.0164	0.0164	0.0094	0.0094	0.1329	0.1329	0.0094	0.2334	0.1454
23	0.1729	0.2833	0.1146	0.2965	0.3113	0.2965	0.1146	0.0948	0.2833	0.1729
24	0.0326	-0.0472	0.0118	-0.0023	-0.1608	-0.0023	0.0118	-0.0472	-0.0424	0.0326
25	0.2655	0.1100	0.3250	-0.0488	0.0693	-0.0488	0.3250	0.1100	-0.0519	0.2655

	11	12	13	14	15	16	17	18	19	University of Al Department of Compu
1	0.2432	0.1591	0.3578	0.2264	0.0319	0.2307	0.0839	0.2575	0.1051	-0.0996
2	0.0920	0.3542	0.3749	0.1380	0.1910	0.2252	-0.0532	0.2006	0.1255	-0.1525
3	0.1911	0.3028	0.3992	0.0937	0.1080	0.2092	0.0566	0.2560	0.0515	-0.2182
4	0.2559	0.1441	0.3620	0.0209	0.1152	0.3738	-0.0865	0.1839	0.1373	0.0164
5	0.0406	0.1927	0.2236	0.1444	0.0930	0.1698	0.0604	0.2347	0.0623	-0.1840
6	-0.0536	0.2374	0.2634	0.1764	-0.0781	0.1659	0.1935	0.1243	-0.0767	-0.2928
7	0.3556	0.1510	0.4087	0.2987	0.1072	0.3472	-0.1464	0.1144	0.1576	0.2181
8	0.1564	0.1682	0.0756	0.1487	0.0826	-0.0478	-0.1982	0.0541	0.2038	0.1643
9	0.1193	0.2710	0.3043	0.1237	0.0849	0.1727	0.1255	0.2342	-0.0159	-0.2286
10	-0.0458	0.2816	0.3239	0.2818	-0.0044	0.3755	-0.1291	0.1101	0.0364	-0.0233
11	1.0000	0.0336	0.3198	0.0935	0.0839	0.2275	-0.0968	0.1356	0.1326	0.3219
12	0.0336	1.0000	0.1470	0.0357	0.1176	0.1287	-0.0979	0.1749	0.0251	-0.0134
13	0.3198	0.1470	1.0000	0.1777	0.0635	0.3640	-0.1857	0.1832	0.2171	0.0559
14	0.0535	0.0357	0.1777	1.0000	-0.0508	0.1164	-0.2364	0.1647	0.0446	0.0758
15	0.0349	0.1176	0.0635	-0.0508	1.0000	0.1073	-0.1916	0.1883	0.0759	0.1107
16	0.2275	0.1287	0.3640	0.1164	0.1073	1.0000	-0.2451	0.1217	0.1248	0.0927
17	-0.0968	-0.0979	-0.1857	-0.2364	-0.1916	-0.2451	1.0000	-0.1183	-0.1765	-0.3139
18	0.1466	0.1749	0.1832	0.1647	0.1883	0.1217	-0.1183	1.0000	0.0575	-0.1923
19	0.1326	0.0281	0.2171	0.0446	0.0759	0.1348	-0.1765	0.0575	1.0000	-0.0839
20	0.3219	-0.0134	0.0559	0.0758	0.1107	0.0927	-0.3139	-0.1923	-0.0839	1.0000
21	-0.1464	0.0662	0.0594	0.0803	-0.0528	-0.0102	-0.0662	0.0848	0.1777	-0.2071
22	0.0277	0.2217	0.2921	-0.0437	0.1458	0.0843	-0.0518	0.1125	-0.1257	0.0074
23	-0.0350	0.1183	0.2114	0.0917	0.0121	0.0972	0.0662	0.0913	-0.2048	-0.1788
24	0.0859	-0.0947	0.0030	0.0439	-0.2464	0.0674	0.1452	-0.0191	-0.0418	-0.5647
25	0.0583	0.1471	0.1711	0.2268	-0.0450	0.0689	-0.1756	0.0489	0.0223	0.2039

	21	22	23	24	25
1	0.0521	0.1032	0.3622	0.0679	0.1090
2	-0.0583	0.2051	0.2841	-0.2659	0.0093
3	-0.0443	0.3199	0.2810	-0.0700	-0.0387
4	-0.0694	0.1382	0.1980	-0.1550	-0.0617
5	-0.1280	0.0968	0.3113	-0.1608	0.0693
6	0.0437	0.1680	0.2965	-0.0023	-0.0488
7	-0.0016	0.1329	0.1146	0.0118	0.3250
8	0.0546	0.0094	0.0948	-0.0472	0.1100
9	-0.1253	0.2334	0.2633	-0.0424	-0.0519
10	0.0548	0.1454	0.1729	0.0326	0.2665
11	-0.1404	0.0277	-0.0850	0.0859	0.0983
12	0.0662	0.2217	0.1183	-0.0947	0.1471
13	0.0594	0.2921	0.2114	0.0030	0.1211
14	0.0803	-0.0437	0.0917	0.0439	0.2868
15	-0.0528	0.1458	0.0121	-0.2464	-0.0450
16	-0.0102	0.0843	0.0972	0.0674	0.0688
17	-0.0685	-0.0518	0.0842	0.1452	-0.1758
18	0.0848	0.1125	0.0913	-0.0151	0.0489
19	0.1377	-0.1257	0.2048	-0.0416	0.0223
20	-0.2071	0.0074	-0.1788	-0.0647	0.2065
21	1.0000	0.0609	-0.0495	0.1158	0.2964
22	0.0609	1.0000	0.0338	-0.0912	0.0419
23	-0.0495	0.0338	1.0000	-0.0652	-0.0699
24	0.1158	-0.0912	-0.0652	1.0000	0.0961
25	0.2964	0.0419	-0.0699	0.0961	1.0000

STRUCTURE ON THE PRIMARY 'S'

	1	2	3	4	5	6	7	8	9	10
1	0.2590	0.4727	0.3477	0.1876	0.2798	0.3520	0.2404	-0.0695	0.3683	0.3102
2	0.1361	0.1556	0.1341	0.0757	0.1398	0.1294	0.0629	0.0140	0.1169	0.0801
3	0.5589	0.2218	0.2004	0.1836	0.2448	0.2058	0.0484	0.1588	0.2416	0.0271
4	0.3390	0.3566	0.2754	0.2288	0.2463	0.2784	0.3109	0.1996	0.2364	0.2886
5	0.2039	0.2214	0.1937	0.1796	0.1035	0.1315	0.1261	0.0247	0.1336	0.6172
6	0.4356	0.3164	0.2812	0.1211	0.1876	0.2907	0.2723	0.0379	0.2009	0.2857
7	0.0783	0.0534	0.0355	0.0447	0.0063	0.0483	0.0150	0.0197	0.0292	0.0672
8	0.1142	0.1370	0.1442	0.1143	0.1150	0.1140	0.1258	0.0186	0.1308	0.0930
9	0.2251	0.5526	0.3219	0.0670	0.3588	0.1028	0.1959	0.1983	0.2916	0.1173
10	0.1499	0.3669	0.3758	0.3009	0.1577	0.2191	0.3116	-0.0622	0.3577	0.3312
11	0.2857	0.4444	0.2729	0.2311	0.1865	0.2745	0.1942	0.2158	0.2844	0.2345
12	0.2678	0.3248	0.3087	0.1429	0.2256	0.2667	0.2091	0.0739	0.2731	0.2063
13	0.4868	0.3758	0.4924	0.4114	0.3376	0.3588	0.2484	0.0700	0.3251	0.4508
14	0.3644	0.3124	0.2956	0.3092	0.2086	0.2647	0.1545	0.0957	0.2603	0.0970
15	0.2933	0.3306	0.2853	0.2122	-0.0047	0.2162	0.0465	0.0984	0.2039	0.1556
16	0.2153	0.5424	0.1935	0.2162	0.1415	0.1702	0.2564	0.0550	0.2135	0.1586
17	0.3703	0.7302	0.3464	0.2559	0.2502	0.2603	0.1926	0.1485	0.2339	0.2293
18	0.4305	0.6615	0.4194	0.3022	0.2749	0.3511	0.3271	0.0637	0.3930	0.3172
19	0.0420	-0.0527	0.0474	0.0302	-0.0645	-0.0418	-0.0615	-0.0757	-0.0515	-0.0902
20	0.4961	0.6212	0.5352	0.3587	0.3317	0.4287	0.2976	0.1650	0.3328	0.3327
21	0.1720	0.2176	0.1913	0.1259	0.1247	0.0915	0.1480	0.0362	0.3284	0.0081
22	0.5354	0.3686	0.4814	0.3609	0.3267	0.3624	0.4799	0.0187	0.4477	0.4150
23	0.2865	0.5689	0.4035	0.3084	0.2506	0.3077	0.5723	0.1230	0.3392	0.2317
24	0.2441	0.4095	0.3143	0.3459	0.3097	0.2354	0.4399	-0.0027	0.3283	0.3450
25	0.2065	0.2632	0.2351	0.2954	0.2128	0.5851	0.2293	0.0068	0.3219	0.1397
26	0.2688	0.3953	0.3240	0.2177	0.2785	0.4903	0.2390	-0.0122	0.2532	0.1769
27	0.4311	0.1884	0.6176	0.2324	0.0906	0.2976	0.3482	-0.0073	0.3556	0.2925
28	0.0814	0.0645	0.2443	0.0981	0.0693	0.0096	0.3359	0.0317	-0.0161	0.1756
29	0.3410	0.4101	0.4210	0.2866	0.3802	0.4427	0.5578	0.0285	0.3859	0.2477
30	0.2895	0.2937	0.3886	0.1541	0.2896	0.2905	0.6587	0.0148	0.3082	0.1417
31	0.1562	0.1322	0.1194	0.1570	0.1331	0.1389	0.0977	-0.0050	0.1332	0.1018
32	0.2079	0.2422	0.2376	0.1312	0.1497	0.2562	0.1774	0.1516	0.7233	0.1646
33	0.3643	0.3525	0.3929	0.2946	0.3871	0.3079	0.3345	0.0533	0.5911	0.2242
34	0.3657	0.3787	0.4617	0.3269	0.3861	0.3676	0.3368	0.0440	0.8043	0.2502
35	0.3038	0.4157	0.5063	0.4224	0.3827	0.2530	0.2916	0.0959	0.4765	0.0431
36	0.6059	0.3123	0.4493	0.4357	0.3513	0.4463	0.2924	0.0647	0.2657	0.4758
37	-0.1775	0.1380	0.0996	0.0631	-0.0430	0.1168	0.1402	-0.0023	0.1394	0.4448
38	0.2878	0.6257	0.5048	0.3529	0.3529	0.4258	0.2896	0.0597	0.3867	0.2472
39	0.3715	0.3254	0.3881	0.2299	0.3394	0.3563	0.2671	0.2036	0.2929	0.5810
40	0.4407	0.5093	0.3344	0.1247	0.2075	0.5961	0.3617	0.0467	0.2692	0.4257
41	0.3769	0.3313	0.2601	0.3302	0.3528	0.3278	0.3173	0.1163	0.1815	0.3774
42	0.6527	0.4394	0.5306	0.3172	0.2964	0.5589	0.1120	0.0028	0.4028	0.2300
43	0.5077	0.4011	0.3205	0.3191	0.3118	0.4807	0.2600	0.0674	0.5659	0.3902
44	0.4315	0.2402	0.3969	0.1892	0.2636	0.3118	0.1611	0.0432	0.3546	0.3902
45	0.4461	0.4301	0.4511	0.2190	0.3170	0.5293	0.1246	-0.0641	0.3930	Departments of Cor
46	0.0701	0.4102	0.5003	0.3286	0.3572	0.4292	0.2805	-0.0136	0.3230	0.3675

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Departments of Cor

47	0.1890	0.2094	0.2286	0.2469	0.2634	0.2791	0.2945	0.3093	0.3234	0.3371	0.3503	0.3630	0.3752	0.3869	0.3981	0.4088	0.4190	0.4287	0.4379	0.4466	0.4548	0.4625	0.4697	0.4764	0.4826	0.4883	0.4935	0.4982	0.5024	0.5071	0.5113	0.5159	0.5200	0.5246	0.5287	0.5333	0.5374	0.5419	0.5464	0.5509	0.5554	0.5599	0.5644	0.5689	0.5734	0.5779	0.5824	0.5869	0.5914	0.5959	0.6004	0.6049	0.6094	0.6139	0.6184	0.6229	0.6274	0.6319	0.6364	0.6409	0.6454	0.6499	0.6544	0.6589	0.6634	0.6679	0.6724	0.6769	0.6814	0.6859	0.6904	0.6949	0.6994	0.7039	0.7084	0.7129	0.7174	0.7219	0.7264	0.7309	0.7354	0.7399	0.7444	0.7489	0.7534	0.7579	0.7624	0.7669	0.7714	0.7759	0.7804	0.7849	0.7894	0.7939	0.7984	0.8029	0.8074	0.8119	0.8164	0.8209	0.8254	0.8299	0.8344	0.8389	0.8434	0.8479	0.8524	0.8569	0.8614	0.8659	0.8704	0.8749	0.8794	0.8839	0.8884	0.8929	0.8974	0.9019	0.9064	0.9109	0.9154	0.9199	0.9244	0.9289	0.9334	0.9379	0.9424	0.9469	0.9514	0.9559	0.9604	0.9649	0.9694	0.9739	0.9784	0.9829	0.9874	0.9919	0.9964	1.0009	1.0054	1.0099	1.0144	1.0189	1.0234	1.0279	1.0324	1.0369	1.0414	1.0459	1.0504	1.0549	1.0594	1.0639	1.0684	1.0729	1.0774	1.0819	1.0864	1.0909	1.0954	1.0999	1.1044	1.1089	1.1134	1.1179	1.1224	1.1269	1.1314	1.1359	1.1404	1.1449	1.1494	1.1539	1.1584	1.1629	1.1674	1.1719	1.1764	1.1809	1.1854	1.1899	1.1944	1.1989	1.2034	1.2079	1.2124	1.2169	1.2214	1.2259	1.2304	1.2349	1.2394	1.2439	1.2484	1.2529	1.2574	1.2619	1.2664	1.2709	1.2754	1.2799	1.2844	1.2889	1.2934	1.2979	1.3024	1.3069	1.3114	1.3159	1.3204	1.3249	1.3294	1.3339	1.3384	1.3429	1.3474	1.3519	1.3564	1.3609	1.3654	1.3699	1.3744	1.3789	1.3834	1.3879	1.3924	1.3969	1.4014	1.4059	1.4104	1.4149	1.4194	1.4239	1.4284	1.4329	1.4374	1.4419	1.4464	1.4509	1.4554	1.4599	1.4644	1.4689	1.4734	1.4779	1.4824	1.4869	1.4914	1.4959	1.5004	1.5049	1.5094	1.5139	1.5184	1.5229	1.5274	1.5319	1.5364	1.5409	1.5454	1.5499	1.5544	1.5589	1.5634	1.5679	1.5724	1.5769	1.5814	1.5859	1.5904	1.5949	1.5994	1.6039	1.6084	1.6129	1.6174	1.6219	1.6264	1.6309	1.6354	1.6399	1.6444	1.6489	1.6534	1.6579	1.6624	1.6669	1.6714	1.6759	1.6804	1.6849	1.6894	1.6939	1.6984	1.7029	1.7074	1.7119	1.7164	1.7209	1.7254	1.7299	1.7344	1.7389	1.7434	1.7479	1.7524	1.7569	1.7614	1.7659	1.7704	1.7749	1.7794	1.7839	1.7884	1.7929	1.7974	1.8019	1.8064	1.8109	1.8154	1.8199	1.8244	1.8289	1.8334	1.8379	1.8424	1.8469	1.8514	1.8559	1.8604	1.8649	1.8694	1.8739	1.8784	1.8829	1.8874	1.8919	1.8964	1.9009	1.9054	1.9099	1.9144	1.9189	1.9234	1.9279	1.9324	1.9369	1.9414	1.9459	1.9504	1.9549	1.9594	1.9639	1.9684	1.9729	1.9774	1.9819	1.9864	1.9909	1.9954	2.0000																																																																																																																																																																																																																																																																																																																																																																																																											
48	0.1895	0.1992	0.2089	0.2186	0.2283	0.2380	0.2477	0.2574	0.2671	0.2768	0.2865	0.2962	0.3059	0.3156	0.3253	0.3350	0.3447	0.3544	0.3641	0.3738	0.3835	0.3932	0.4029	0.4126	0.4223	0.4320	0.4417	0.4514	0.4611	0.4708	0.4805	0.4902	0.5000	0.5097	0.5194	0.5291	0.5388	0.5485	0.5582	0.5679	0.5776	0.5873	0.5970	0.6067	0.6164	0.6261	0.6358	0.6455	0.6552	0.6649	0.6746	0.6843	0.6940	0.7037	0.7134	0.7231	0.7328	0.7425	0.7522	0.7619	0.7716	0.7813	0.7910	0.8007	0.8104	0.8201	0.8298	0.8395	0.8492	0.8589	0.8686	0.8783	0.8880	0.8977	0.9074	0.9171	0.9268	0.9365	0.9462	0.9559	0.9656	0.9753	0.9850	0.9947	1.0044	1.0141	1.0238	1.0335	1.0432	1.0529	1.0626	1.0723	1.0820	1.0917	1.1014	1.1111	1.1208	1.1305	1.1402	1.1499	1.1596	1.1693	1.1790	1.1887	1.1984	1.2081	1.2178	1.2275	1.2372	1.2469	1.2566	1.2663	1.2760	1.2857	1.2954	1.3051	1.3148	1.3245	1.3342	1.3439	1.3536	1.3633	1.3730	1.3827	1.3924	1.4021	1.4118	1.4215	1.4312	1.4409	1.4506	1.4603	1.4700	1.4797	1.4894	1.4991	1.5088	1.5185	1.5282	1.5379	1.5476	1.5573	1.5670	1.5767	1.5864	1.5961	1.6058	1.6155	1.6252	1.6349	1.6446	1.6543	1.6640	1.6737	1.6834	1.6931	1.7028	1.7125	1.7222	1.7319	1.7416	1.7513	1.7610	1.7707	1.7804	1.7901	1.8000	1.8097	1.8194	1.8291	1.8388	1.8485	1.8582	1.8679	1.8776	1.8873	1.8970	1.9067	1.9164	1.9261	1.9358	1.9455	1.9552	1.9649	1.9746	1.9843	1.9940	2.0037	2.0134	2.0231	2.0328	2.0425	2.0522	2.0619	2.0716	2.0813	2.0910	2.1007	2.1104	2.1201	2.1298	2.1395	2.1492	2.1589	2.1686	2.1783	2.1880	2.1977	2.2074	2.2171	2.2268	2.2365	2.2462	2.2559	2.2656	2.2753	2.2850	2.2947	2.3044	2.3141	2.3238	2.3335	2.3432	2.3529	2.3626	2.3723	2.3820	2.3917	2.4014	2.4111	2.4208	2.4305	2.4402	2.4499	2.4596	2.4693	2.4790	2.4887	2.4984	2.5081	2.5178	2.5275	2.5372	2.5469	2.5566	2.5663	2.5760	2.5857	2.5954	2.6051	2.6148	2.6245	2.6342	2.6439	2.6536	2.6633	2.6730	2.6827	2.6924	2.7021	2.7118	2.7215	2.7312	2.7409	2.7506	2.7603	2.7700	2.7797	2.7894	2.7991	2.8088	2.8185	2.8282	2.8379	2.8476	2.8573	2.8670	2.8767	2.8864	2.8961	2.9058	2.9155	2.9252	2.9349	2.9446	2.9543	2.9640	2.9737	2.9834	2.9931	3.0028	3.0125	3.0222	3.0319	3.0416	3.0513	3.0610	3.0707	3.0804	3.0901	3.1000	3.1097	3.1194	3.1291	3.1388	3.1485	3.1582	3.1679	3.1776	3.1873	3.1970	3.2067	3.2164	3.2261	3.2358	3.2455	3.2552	3.2649	3.2746	3.2843	3.2940	3.3037	3.3134	3.3231	3.3328	3.3425	3.3522	3.3619	3.3716	3.3813	3.3910	3.4007	3.4104	3.4201	3.4298	3.4395	3.4492	3.4589	3.4686	3.4783	3.4880	3.4977	3.5074	3.5171	3.5268	3.5365	3.5462	3.5559	3.5656	3.5753	3.5850	3.5947	3.6044	3.6141	3.6238	3.6335	3.6432	3.6529	3.6626	3.6723	3.6820	3.6917	3.7014	3.7111	3.7208	3.7305	3.7402	3.7499	3.7596	3.7693	3.7790	3.7887	3.7984	3.8081	3.8178	3.8275	3.8372	3.8469	3.8566	3.8663	3.8760	3.8857	3.8954	3.9051	3.9148	3.9245	3.9342	3.9439	3.9536	3.9633	3.9730	3.9827	3.9924	4.0021	4.0118	4.0215	4.0312	4.0409	4.0506	4.0603	4.0700	4.0797	4.0894	4.0991	4.1088	4.1185	4.1282	4.1379	4.1476	4.1573	4.1670	4.1767	4.1864	4.1961	4.2058	4.2155	4.2252	4.2349	4.2446	4.2543	4.2640	4.2737	4.2834	4.2931	4.3028	4.3125	4.3222	4.3319	4.3416	4.3513	4.3610	4.3707	4.3804	4.3901	4.4000	4.4097	4.4194	4.4291	4.4388	4.4485	4.4582	4.4679	4.4776	4.4873	4.4970	4.5067	4.5164	4.5261	4.5358	4.5455	4.5552	4.5649	4.5746	4.5843	4.5940	4.6037	4.6134	4.6231	4.6328	4.6425	4.6522	4.6619	4.6716	4.6813	4.6910	4.7007	4.7104	4.7201	4.7298	4.7395	4.7492	4.7589	4.7686	4.7783	4.7880	4.7977	4.8074	4.8171	4.8268	4.8365	4.8462	4.8559	4.8656	4.8753	4.8850	4.8947	4.9044	4.9141	4.9238	4.9335	4.9432	4.9529	4.9626	4.9723	4.9820	4.9917	5.0014	5.0111	5.0208	5.0305	5.0402	5.0499	5.0596	5.0693	5.0790	5.0887	5.0984	5.1081	5.1178	5.1275	5.1372	5.1469	5.1566	5.1663	5.1760	5.1857	5.1954	5.2051	5.2148	5.2245	5.2342	5.2439	5.2536	5.2633	5.2730	5.2827	5.2924	5.3021	5.3118	5.3215	5.3312	5.3409	5.3506	5.3603	5.3700	5.3797	5.3894	5.3991	5.4088	5.4185	5.4282	5.4379	5.4476	5.4573	5.4670	5.4767	5.4864	5.4961	5.5058	5.5155	5.5252	5.5349	5.5446	5.5543	5.5640	5.5737	5.5834	5.5931	5.6028	5.6125	5.6222	5.6319	5.6416	5.6513	5.6610	5.6707	5.6804	5.6901	5.7000	5.7097	5.7194	5.7291	5.7388	5.7485	5.7582	5.7679	5.7776	5.7873	5.7970	5.8067	5.8164	5.8261	5.8358	5.8455	5.8552	5.8649	5.8746	5.8843	5.8940	5.9037	5.9134	5.9231	5.9328	5.9425	5.9522	5.9619	5.9716	5.9813	5.9910	6.0007	6.0104	6.0201	6.0298	6.0395	6.0492	6.0589	6.0686	6.0783	6.0880	6.0977	6.1074	6.1171	6.1268	6.1365	6.1462	6.1559	6.1656	6.1753	6.1850	6.1947	6.2044	6.2141	6.2238	6.2335	6.2432	6.2529	6.2626	6.2723	6.2820	6.2917	6.3014	6.3111	6.3208	6.3305	6.3402	6.3499	6.3596	6.3693	6.3790	6.3887	6.3984	6.4081	6.4178	6.4275	6.4372	6.4469	6.4566	6.4663	6.4760	6.4857	6.4954	6.5051	6.5148	6.5245	6.5342	6.5439	6.5536	6.5633	6.5730	6.5827	6.5924	6.6021	6.6118	6.6215	6.6312	6.6409	6.6506	6.6603	6.6700	6.6797	6.6894	6.6991	6.7088	6.7185	6.7282	6.7379	6.7476	6.7573	6.7670	6.7767	6.7864	6.7961	6.8058	6.8155	6.8252	6.8349	6.8446	6.8543	6.8640	6.8737	6.8834	6.8931	6.9028	6.9125	6.9222	6.9319	6.9416	6.9513	6.9610	6.9707	6.9804	6.9901	7.0000	7.0097	7.0194	7.0291	7.0388	7.0485	7.0582	7.0679	7.0776	7.0873	7.0970	7.1067	7.1164	7.1261	7.1358	7.1455	7.1552	7.1649	7.1746	7.1843	7.1940	7.2037	7.2134	7.2231	7.2328	7.2425	7.2522	7.2619	7.2716	7.2813	7.2910	7.3007	7.3104	7.3201	7.3298	7.3395	7.3492	7.3589	7.3686	7.3783	7.3880	7.3977	7.4074	7.4171	7.4268	7.4365	7.4462	7.4559	7.4656	7.4753	7.4850	7.4947	7.5044	7.5141	7.5

	11	12	13	14	15	16	17	18	19	20
1	0.1551	0.1810	0.3410	0.0074	0.3080	0.3353	0.0036	0.0891	-0.0338	-0.0447
2	0.0232	0.0683	0.1019	-0.0037	0.0480	0.0616	0.0185	0.1081	0.0280	-0.0338
3	0.1410	0.2933	0.0634	0.1423	0.0159	0.1489	0.0155	0.1934	-0.0433	0.0601
4	0.1241	0.2041	0.2135	0.0734	0.0392	0.0470	0.0767	0.0282	0.0435	0.0670
5	0.0566	0.0841	0.1633	0.0502	0.0848	0.0467	0.0332	0.0459	0.0489	0.0566
6	0.0363	0.1943	0.1827	0.0969	0.0544	0.2084	0.0051	-0.0977	-0.0566	Department of A
7	-0.0027	0.0166	0.0323	0.0032	-0.0034	0.0628	0.0089	0.0108	-0.0181	Department of A
8	0.0771	0.0554	0.1150	0.0263	0.0692	0.0766	0.0395	0.0394	0.0214	Department of A
9	0.1441	0.1596	0.3487	0.1399	0.2919	-0.0183	-0.0864	0.2030	0.0262	Department of A
10	0.4466	0.0550	0.3709	0.1895	-0.1374	0.2631	-0.0128	0.1741	0.0996	Department of A
11	0.1687	0.2853	0.4498	-0.0500	0.1004	0.1069	0.1352	0.1584	0.2922	Department of A
12	0.5761	0.1453	0.2309	0.1358	0.0685	0.0961	0.0496	0.1277	0.0180	Department of A
13	0.1723	0.2604	0.3527	0.1217	0.2271	0.3001	-0.0379	0.2911	0.0276	Department of A
14	0.4004	0.1563	0.3686	-0.0142	0.1108	0.1217	0.1071	0.0573	0.0829	Department of A
15	0.0502	0.2188	0.4468	0.0578	-0.1029	0.1663	-0.2341	0.2112	0.2132	Department of A
16	0.2360	0.2033	0.3460	-0.0061	-0.0016	0.2261	-0.0091	0.0654	-0.1779	Department of A
17	0.1712	0.1492	0.3139	0.1594	0.1203	0.2293	0.0091	0.1603	0.1409	Department of A
18	0.0675	0.1841	0.2173	0.1399	0.0173	0.1960	0.0220	0.1443	0.1092	Department of A
19	0.0564	-0.1480	0.2729	0.0038	0.0380	0.0648	-0.1334	0.0571	-0.3898	Department of A
20	0.2200	0.2426	0.3533	0.1445	0.1244	0.1539	0.1720	0.2248	0.0692	Department of A
21	0.1855	0.2336	-0.1238	0.1891	0.0866	-0.0017	0.0709	0.2802	-0.1764	Department of A
22	0.2534	0.1371	0.3178	0.2195	0.1714	0.3093	-0.0174	0.1440	0.0258	Department of A
23	0.1562	0.1019	0.3685	0.1355	0.1189	0.2991	-0.1249	0.0705	0.2031	Department of A
24	0.2233	0.3254	0.3271	0.1556	0.1737	0.3851	-0.2870	0.3521	0.0230	Department of A
25	0.0572	0.0965	0.1916	0.0511	0.1239	0.1145	-0.0055	0.1553	0.1141	Department of A
26	-0.0105	0.1713	0.2578	0.1465	0.2887	0.1987	-0.1246	0.1131	-0.0058	Department of A
27	0.3176	0.1110	0.3020	0.2031	0.0105	0.0661	0.1480	0.2148	-0.1938	Department of A
28	0.4042	0.1832	0.1461	0.0939	0.1900	0.1665	-0.1065	0.0914	0.1244	Department of A
29	0.0572	0.1940	0.2280	0.0878	0.1161	0.1108	0.2151	0.1423	-0.0050	Department of A
30	0.1728	0.1774	0.1614	0.1812	0.1055	0.1076	0.0763	0.1281	-0.0662	Department of A
31	0.0089	0.1140	0.0812	0.0281	0.0696	0.0442	-0.0010	0.0918	0.0191	Department of A
32	0.1035	0.1429	0.0851	0.1145	0.0482	0.0706	-0.0016	0.0683	-0.0235	Department of A
33	0.1360	0.2674	0.3882	0.1168	0.0510	0.1612	-0.0034	0.2627	0.1802	Department of A
34	0.1647	0.2391	0.3373	0.1461	0.0617	0.2329	0.0296	0.1993	0.1502	Department of A
35	0.3741	0.1122	0.2563	0.1841	0.1060	0.0124	-0.1420	0.1347	0.0946	Department of A
36	0.0710	0.1070	0.2318	0.1980	-0.0262	0.2361	0.1596	0.1414	0.0597	Department of A
37	-0.0405	0.2823	0.3040	0.1593	0.0184	0.1059	-0.1704	0.0478	0.0521	Department of A
38	0.1372	0.2166	0.2022	0.1225	0.1668	0.1203	0.0432	0.0442	-0.0987	Department of A
39	0.1416	0.2287	0.1744	0.1373	0.0614	0.1900	-0.0042	0.2493	0.0156	Department of A
40	0.0237	0.1389	0.2777	0.1942	0.0429	0.2003	0.0100	-0.0122	0.0503	Department of A
41	0.0054	0.2818	0.2199	0.0642	-0.0270	0.1579	0.0111	0.0011	-0.0635	Department of A
42	-0.0387	0.1615	0.0725	0.1411	0.1053	0.1939	0.1506	0.1563	-0.0110	Department of A
43	0.1302	0.2903	0.2050	0.2495	0.0930	0.2900	0.0110	0.3732	-0.0573	Department of A
44	-0.1252	0.1525	0.1565	0.0798	0.1327	0.0497	-0.0262	0.2194	0.0939	Department of A
45	0.0287	0.2877	0.2622	0.1689	-0.0686	0.0794	0.1659	0.3063	-0.0299	Department of A
46	0.0774	0.1531	0.2516	0.1021	0.0037	0.3547	0.0101	0.0890	0.1148	Department of A
47	0.0067	0.1647	0.1712	0.1858	-0.2434	0.0939	0.1003	-0.0629	-0.0915	Department of A
48	-0.0602	0.2512	0.2611	0.1761	-0.1010	0.1612	-0.1601	0.2545	0.0455	Department of A
49	0.0483	0.2576	0.2795	0.0666	0.2544	0.1155	0.2802	0.1280	-0.2299	Department of A
50	0.1631	0.7150	0.1245	-0.0742	0.0711	0.1718	0.1144	0.0703	-0.0139	Department of A

51	-0.0051	0.5742	0.1709	-0.1300	0.1370	0.2320	-0.2207	0.1488	0.1289	-0.0015
52	-0.0092	0.7107	0.1135	0.3446	-0.0624	-0.0133	0.0401	0.0544	0.1044	-0.0765
53	0.1311	-0.0301	0.0673	-0.0234	-0.1055	0.0917	0.0806	0.6603	0.0732	-0.0544
54	-0.0326	0.0667	0.0468	0.0783	0.0821	-0.0290	-0.0760	0.7188	-0.0327	0.0390
55	0.3153	0.3137	0.1540	0.0581	0.0095	0.1618	-0.3130	-0.0931	0.1193	-0.2060
56	0.1107	0.1476	0.2554	0.0999	0.0303	0.0560	0.0716	0.1451	0.0617	-0.2044
57	0.1485	0.1921	0.2935	0.1234	0.0620	0.1812	-0.1276	0.2091	0.0385	-0.1452
58	0.0684	0.1194	0.3213	0.1387	-0.1233	0.2010	0.1415	0.1217	0.0745	-0.2177
59	0.2946	0.0348	0.3645	0.1764	-0.1911	0.1964	0.2076	0.1073	0.0827	-0.1410
60	0.2738	0.0886	0.3613	0.1074	-0.0076	0.2587	0.1231	0.2296	-0.1107	0.0243
61	0.1672	0.2589	0.4342	0.0726	0.1517	0.1519	0.0179	0.2324	0.1436	-0.0965
62	0.2167	0.1872	0.4726	0.3204	0.0563	0.3188	-0.0621	0.1905	0.1119	-0.1760
63	0.0426	0.0734	0.4892	0.1004	0.0088	0.1835	0.0202	-0.0101	0.1487	-0.0720
64	0.1474	0.1342	0.1771	0.1045	0.0926	0.1477	-0.1064	0.1668	0.1021	-0.0426
65	0.0097	0.1680	0.1796	-0.0456	0.0495	0.0645	0.0901	0.1150	0.0045	0.0196
66	0.1475	0.0678	0.1984	0.3091	0.0827	0.1788	0.0902	0.2775	0.1976	-0.2755
67	0.0535	0.2103	0.1572	0.1989	0.0506	0.0546	0.1060	0.2274	0.0031	-0.0402
68	0.1580	0.0494	0.1488	0.4593	0.1483	0.2153	-0.2886	0.2877	0.2178	0.0863
69	0.0545	0.2385	0.2226	0.4319	-0.1058	0.0698	0.0428	0.2174	-0.0108	-0.0723
70	0.3006	0.2343	0.2823	0.3468	0.0113	0.1920	-0.1258	0.2005	0.0104	0.0004
71	0.1957	0.1039	0.2155	0.7467	0.0133	0.0948	0.0385	0.1569	-0.0005	-0.0005
72	0.0113	0.0974	0.1895	0.4287	0.2368	0.3967	-0.2379	-0.0111	0.1821	Departments of Compl
73	0.1007	0.1567	0.1022	0.1049	0.0602	0.2047	-0.0295	0.0849	0.1371	-0.0331
74	0.1526	0.0543	0.2081	0.1378	0.0564	0.1919	0.1298	0.1520	0.0762	0.1173
75	0.1263	0.0812	0.2585	0.0499	-0.0203	0.1194	-0.0259	0.0599	0.1848	0.1255
76	0.3083	0.1424	0.4423	0.2927	0.0215	0.0037	-0.2216	0.1485	0.0429	0.1954
77	0.1488	0.0340	0.6170	0.0840	0.0538	0.1082	0.0562	0.0741	-0.0163	-0.0120
78	0.2835	0.0005	0.5076	0.1918	0.1862	0.1856	-0.0484	0.2923	0.1288	-0.0902
79	0.2490	0.2107	0.4116	-0.0070	0.3072	0.2053	0.1316	0.2610	0.1575	-0.0320
80	0.0764	0.0644	0.3981	0.1493	0.0104	0.1911	0.0255	0.1598	-0.1146	-0.0342
81	0.3159	0.1693	0.0587	-0.3167	0.1263	0.2059	0.1128	0.1922	0.1713	-0.0382
82	0.2816	0.1753	0.4894	0.1495	0.0402	0.4397	-0.0945	0.2292	0.1783	-0.0397
83	0.3368	0.0077	0.2726	0.0123	-0.0469	0.1845	0.2464	0.1159	0.2903	-0.0392
84	0.2287	0.1655	0.3165	0.0818	-0.0703	0.1737	0.2487	-0.0432	0.1161	-0.1045
85	0.1841	0.1629	0.4208	0.1828	0.1293	0.2225	0.1802	0.1021	0.1999	-0.0217
86	0.1679	0.2001	0.2504	0.0929	0.0531	0.2395	0.5018	0.1289	0.0982	-0.0593
87	0.0885	0.3609	0.1517	-0.0522	0.0542	0.0461	0.1236	0.0120	0.1420	-0.0942
88	-0.0122	-0.0109	0.0250	-0.0557	0.0412	0.0104	-0.0387	0.0242	0.7501	0.0422
89	0.1913	0.1789	0.2307	0.1138	-0.0092	0.1636	0.0172	0.1605	0.0044	-0.0023
90	0.0874	0.1826	0.2023	0.1999	0.1095	0.1178	-0.0377	0.1698	0.0418	-0.1075
91	0.0449	-0.0103	0.0747	0.0983	-0.0113	-0.6148	-0.1140	0.0596	0.0442	0.0598
92	0.1328	0.1944	0.3376	0.1526	0.0269	0.7418	-0.0238	0.1598	0.1113	-0.0400
93	0.2160	0.2203	0.2722	0.2809	0.1427	0.1109	-0.0277	0.2714	0.1114	-0.0161
94	0.1225	0.1245	0.3372	0.1464	-0.0496	0.2319	-0.0707	0.1818	0.0250	-0.0179
95	0.3424	-0.0159	0.2377	0.2967	0.1539	0.2473	-0.2641	0.0445	0.1468	0.2743
96	0.1072	0.1128	0.1783	0.0865	0.6593	0.1186	0.0106	0.0432	0.0726	-0.0140
97	0.0429	0.2834	0.2643	-0.0929	0.3939	0.2137	-0.0183	0.1907	-0.0975	-0.1205
98	0.2398	0.1889	0.2394	0.1241	0.2276	0.1531	-0.1252	0.2501	0.2566	-0.0270
99	0.0761	0.1304	0.1544	0.0460	0.0545	0.0538	-0.0097	0.1457	0.0418	-0.0595

	21	22	23	24	25
1	-0.1063	0.1186	0.2323	0.0031	-0.0318
2	0.0055	0.6959	0.0485	0.0029	0.0086
3	-0.0031	0.0365	0.1398	-0.1308	0.0788
4	0.0134	0.0212	0.1597	-0.0308	0.1672
5	0.0573	0.1646	0.0537	-0.0626	0.0250
6	-0.0084	0.1916	-0.0728	0.1527	0.3483
7	0.0128	0.0236	0.0313	0.0010	0.5910
8	0.5448	0.0593	0.1140	-0.0145	0.0149
9	-0.1744	0.2114	0.3455	-0.3521	0.1283
10	-0.2090	0.0778	-0.0062	0.0682	-0.0186
11	0.1353	0.0765	0.2551	0.1081	0.1071
12	0.0483	0.0750	0.1752	0.0052	0.0550
13	0.0605	0.2035	0.1852	-0.1155	0.0896
14	0.0028	0.2970	0.2503	-0.0455	-0.0273
15	0.2985	0.2301	0.2500	0.0155	-0.0603
16	-0.2651	0.1316	-0.0091	-0.0316	-0.1033
17	0.1694	0.1737	0.1999	0.0841	0.0925
18	0.0663	0.2096	0.1499	0.0107	0.1201
19	-0.0735	0.2656	0.4104	0.0689	-0.0127
20	0.1629	0.1966	0.1994	-0.0321	0.1201
21	-0.1190	0.1867	0.0618	0.0874	0.1174
22	-0.1802	0.1468	0.2773	-0.0670	0.1062
23	0.1978	0.1663	0.1086	-0.0843	0.0310
24	0.0317	0.2204	-0.0483	-0.1809	0.2356
25	0.0262	0.0945	-0.0313	-0.0278	0.0381
26	0.1825	0.1177	0.3367	-0.1510	0.0624
27	0.0767	0.2603	0.0441	0.0981	0.2219
28	0.2322	0.1420	-0.0928	-0.1581	0.2037
29	0.0696	0.1300	0.2020	-0.0659	-0.0054
30	-0.0911	0.1316	0.0542	-0.0557	0.0241
31	-0.0143	0.0811	0.0994	-0.0718	-0.0088
32	-0.0340	0.0305	-0.0218	-0.0292	-0.0161
33	0.1403	0.1406	0.4876	-0.0529	0.2971
34	0.0200	0.2220	0.3043	0.0445	0.1257
35	-0.0560	0.1809	0.1430	-0.2305	-0.1395
36	0.2358	0.1349	0.2746	0.0308	0.1103
37	-0.1082	0.0331	0.0783	-0.0260	0.1544
38	-0.0986	0.1303	0.2105	-0.3086	0.0182
39	-0.0079	-0.1252	0.1801	0.1136	0.1679
40	-0.0489	0.0458	0.2420	-0.0745	0.1957
41	-0.0184	0.2531	0.4766	-0.2074	0.1961
42	-0.1625	0.0596	0.4106	-0.0653	-0.3207
43	0.0491	0.1468	0.3118	0.0657	0.0549
44	-0.0776	0.1978	0.3635	-0.1203	-0.1883
45	0.0681	0.0253	0.1800	0.0787	0.0160
46	-0.1617	0.1694	0.2711	0.0297	-0.1020
47	0.0528	0.1012	0.0406	0.0517	0.0767
48	0.3080	0.1513	0.1622	-0.0729	0.1555
49	0.1126	0.4309	0.0978	-0.0550	0.1560
50	-0.0573	0.0410	0.1024	0.0011	-0.0106

51	-0.0565	C.372	0.0972	-0.1492	0.0463
52	-0.0778	C.1540	0.1644	C.0358	0.0376
53	-0.0577	C.0292	0.1195	C.1618	0.0020
54	0.0529	C.1992	0.0085	-0.1165	0.0000
55	0.0269	C.1140	0.0999	C.2127	C.0707
56	0.1223	C.2950	0.0611	C.0222	C.0351
57	0.0650	C.0528	0.0999	C.0353	-0.0024
58	0.0842	C.0600	0.3695	0.1737	0.0693
59	0.1856	C.0412	0.0561	0.2687	0.0909
60	-0.2156	C.0923	0.1168	0.1232	-0.2131
61	-0.0228	C.2372	0.2033	C.0795	-0.1090
62	0.0685	C.2476	0.1523	C.0083	0.1044
63	-0.0752	C.2417	0.3371	-0.1223	-0.0141
64	0.0410	C.1229	0.1376	-0.0237	0.0184
65	0.0018	0.1567	0.1320	-0.0815	-0.0267
66	-0.0501	-0.0510	0.2444	0.0622	0.0699
67	-0.1272	0.1528	0.1257	C.0674	0.1131
68	0.0443	-0.1193	0.1585	-0.1269	C.1442
69	0.1014	C.1295	0.2260	-0.0733	0.2029
70	-0.0223	0.1978	0.2422	-0.0514	0.1534
71	-0.0601	0.0542	0.1157	-0.0378	0.0395
72	-0.0221	0.0812	0.0280	-0.1409	-0.1728
73	0.0076	-0.0088	0.1392	-0.1043	0.0951
74	-0.1812	-0.0134	0.2349	0.1379	0.0242
75	0.0845	-0.0226	0.1323	0.1593	0.0494
76	-0.0548	C.0306	-0.1563	-0.2562	0.0779
77	-0.0135	0.0993	C.0702	0.0018	0.0650
78	0.0739	C.1775	0.1348	0.0228	0.0051
79	0.1267	0.1574	C.1481	-0.1738	-0.0343
80	-0.1306	C.2024	-0.2129	-0.0718	0.0352
81	-0.0842	C.1515	0.0967	-0.0936	-0.1982
82	0.0730	C.2956	0.0260	-0.0378	0.2422
83	-0.0031	-0.1160	0.2462	-0.1396	-0.0002
84	-0.1690	0.0126	0.2175	-0.0631	-0.0173
85	-0.0453	C.1271	C.2171	-0.0566	0.1528
86	0.0163	0.1074	0.1513	-0.0060	0.0576
87	-0.0145	0.2935	0.1978	-0.0134	-0.0194
88	-0.0293	C.0274	0.0730	-0.0163	-0.0524
89	-0.0338	C.0925	0.1577	0.0222	0.1183
90	C.0343	0.1139	0.1267	0.0017	0.0462
91	-0.0217	0.0174	-0.0252	-0.0137	0.0145
92	-0.0013	0.1509	0.1808	-0.0663	0.1326
93	-0.0087	C.0980	0.1568	-0.0663	0.0649
94	C.0340	0.1604	C.1912	0.0181	C.0834
95	0.0421	-0.1450	C.1458	0.2062	0.3037
96	0.0156	0.0952	0.1091	-0.0197	0.0554
97	-0.0411	C.4765	-0.0589	-0.0231	0.0443
98	0.0654	C.2190	0.1438	0.0807	0.1482
99	-0.0148	C.1141	0.1318	0.0005	C.0128

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